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CALSPAN ADVANCED TECHNOLOGY CENTER

IMPROVED LIGHTWEIGHT SUBCOMPACT
SIDE STRUCTURE CRASH TEST REPORT

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Calspan Report No. 6225-V-16

Prepared For:

THE BUDD COMPANY
TECHNICAL CENTER
FORT WASHINGTON, PA 19034

PURCHASE ORDER NO. TC17645

TEST: TEST NO. 14
TYPE OF TEST: CAR-TO-CAR FRONT-TO-SIDE OBLIQUE
TEST DATE: 22 AUGUST 1979

A DIVISION OF CALSPAN CORPORATION
AN ARVIN COMPANY P.O. BOX 400 BUFFALO, NEW YORK 14225

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TEST OBJECTIVE

The objective of this 60° oblique side impact was to obtain performance data on the modified side structure of a 1976 Volkswagen Rabbit. The Budd Co. performed the heavyweight (approximately 40 pounds per side) alteration. This test was a 30 MPH, 60° oblique impact by an unmodified 1978 Chevrolet Impala into the left side of the VW Rabbit at the DOR point.

A secondary objective was to obtain side impact dummy data using the newly modified side impact dummy developed by HSRI under contract to the DOT/ NHTSA. This dummy was placed in the struck vehicle driver position.

This test program is part of the National Highway Traffic Safety Administration (NHTSA) Contract DOT-HS-7-01588 to improve subcompact side structures.

PRESENTATION OF RESULTS

This test report presents the test results from a car-to-car, front-to-side, 60° oblique, impact. Included in this document are still photographs, vehicle and dummy response data in plotted form, vehicle interior and exterior damage sketches, pre- and post-test measurements for side intrusion and door crush, and a discussion of the data collected. High speed motion pictures and color photographs were obtained and submitted to the sponsor under separate cover.

Table 1

CRASH TEST SUMMARY

TEST NO. 14

PROJECT Improved Lightweight Subcompact Side Structure

DATE 8-22-79

TIME 11:55 TEMP. 79°

TEST CONDITION Car-to-Car, 60° Side Oblique

VEHICLE NO. 1 1978 Chevrolet Impala

VEHICLE NO. 2 1976 Volkswagen Rabbit (modified)

	VEH. NO. 1	VEH. NO. 2
TEST WEIGHT (lbs)	3710	2340
IMPACT ANGLE (deg)*	0	300
IMPACT VELOCITY (mph)**	30.1	0
MAX. CRUSH (in)	5.25	14.12
MAX. INTRUSION (in)	-	11.63 @ 11.75 in. above sill

DUMMIES	VEH. NO. 1	VEH. NO. 2	
TYPE	Hybrid II, Part 572	Side Impact Dummy***	Hybrid II, Part 572
LOCATION	LF(1)	LF(1)	RF(2)
RESTRAINT	Production 3-Pt. System	Unrestrained	Unrestrained

NUMBER OF DATA CHANNELS 73

NUMBER OF HIGH SPEED CAMERAS 10

*WITH RESPECT TO TOW TRACK CENTERLINE

**SPEED TRAP MEASUREMENT (±0.5% ACCURACY)

***MODIFIED PART 572 DUMMY FOR SIDE IMPACTS

Table 1 (Continued)

OBSERVATIONS (VEHICLE NO. 1) - 1978 Chevrolet Impala

GLAZING Undamaged

DOORS Undamaged

SEAT ANCHORAGES Intact

RESTRAINTS Intact

OBSERVATIONS (VEHICLE NO. 2) - 1976 VW Rabbit (Modified)

GLAZING Windshield cracked but in place, Driver side front and rear windows broken out

DOORS Driver's side jammed, Passenger side operable

SEAT ANCHORAGES Driver seat crushed, Passenger seat sustained little damage

RESTRAINTS -

GENERAL COMMENTS Door hinges and interlocks held but A-pillar, B-pillar, roof, and sill yielded. A-pillar rotated counterclockwise (looking down on vehicle). B-pillar failed in bending at mid-height joint. Roof buckled at B-pillar connection. Sill rotated upward due to interlocks. In general the stiffened side structure transferred load into vehicle body which could not sustain it.

Driver occupant head broke driver side window on impact and contacted Impala hood. Passenger head hit interior roof at approximately the center line.

Table 1 (Continued)

GENERAL COMMENTS

Data Quality:

- All cameras operated properly.
- Impala rear deck z accelerometer (pack 3) underwent a zero shift at 90 msec.
- VW Rabbit right rear sill z accelerometer (pack 2) has a noise spike at 290 msec.
- Impala Driver inboard belt load transducer did not operate correctly.
- VW Rabbit Driver upper sternum x (channel 42) has a noise spike at 190 msec.

Table 2

VEHICLE TEST WEIGHTS - TEST NO. 14

CAR 1 - 1978 Chevrolet Impala

Left Front	1090 lbs.		Left Rear	780 lbs.	
Right Front	1010 lbs.		Right Rear	830 lbs.	
Total Front	2100 lbs.		Total Rear	1610 lbs.	
Total Weight =	2100 lbs.	+	1610 lbs. =	3710 lbs.	
Wheel Base	116 in.				
Cg_{FW} =	1610 lbs. X 116 in.			=	50.3 in.
	3710 lbs.				

CAR 2 - 1976 VW Rabbit (Modified)

Left Front	680 lbs.		Left Rear	460 lbs.	
Right Front	700 lbs.		Right Rear	500 lbs.	
Total Front	1380 lbs.		Total Rear	960 lbs.	
Total Weight =	1380 lbs.	+	960 lbs. =	2340 lbs.	
Wheel Base	94.5 in.				
Cg_{FW} =	1380 lbs. X 94.5 in.			=	38.8 in.
	2340 lbs.				

Figure 1 PRE-TEST NO. 14 - IMPACT CONFIGURATION

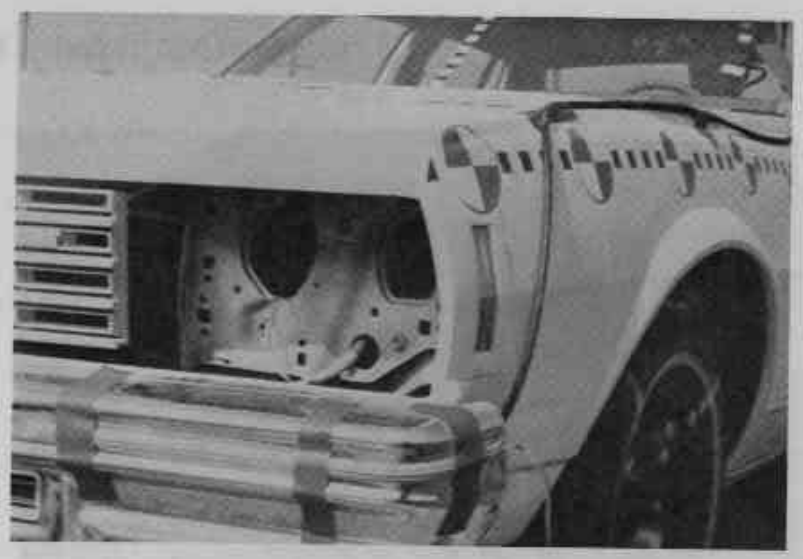


Figure 2 PRE- AND POST-TEST NO. 14 - VEHICLE 1, 1978 CHEVROLET IMPALA

Figure 3 PRE- AND POST-TEST NO. 14 - VEHICLE 2, 1976 VW RABBIT

Figure 4 IMPALA PRE- AND POST-TEST OCCUPANT POSITION

Figure 5 VW RABBIT PRE- AND POST-TEST OCCUPANT POSITIONS

Figure 6 VW RABBIT POST-TEST INTERIOR

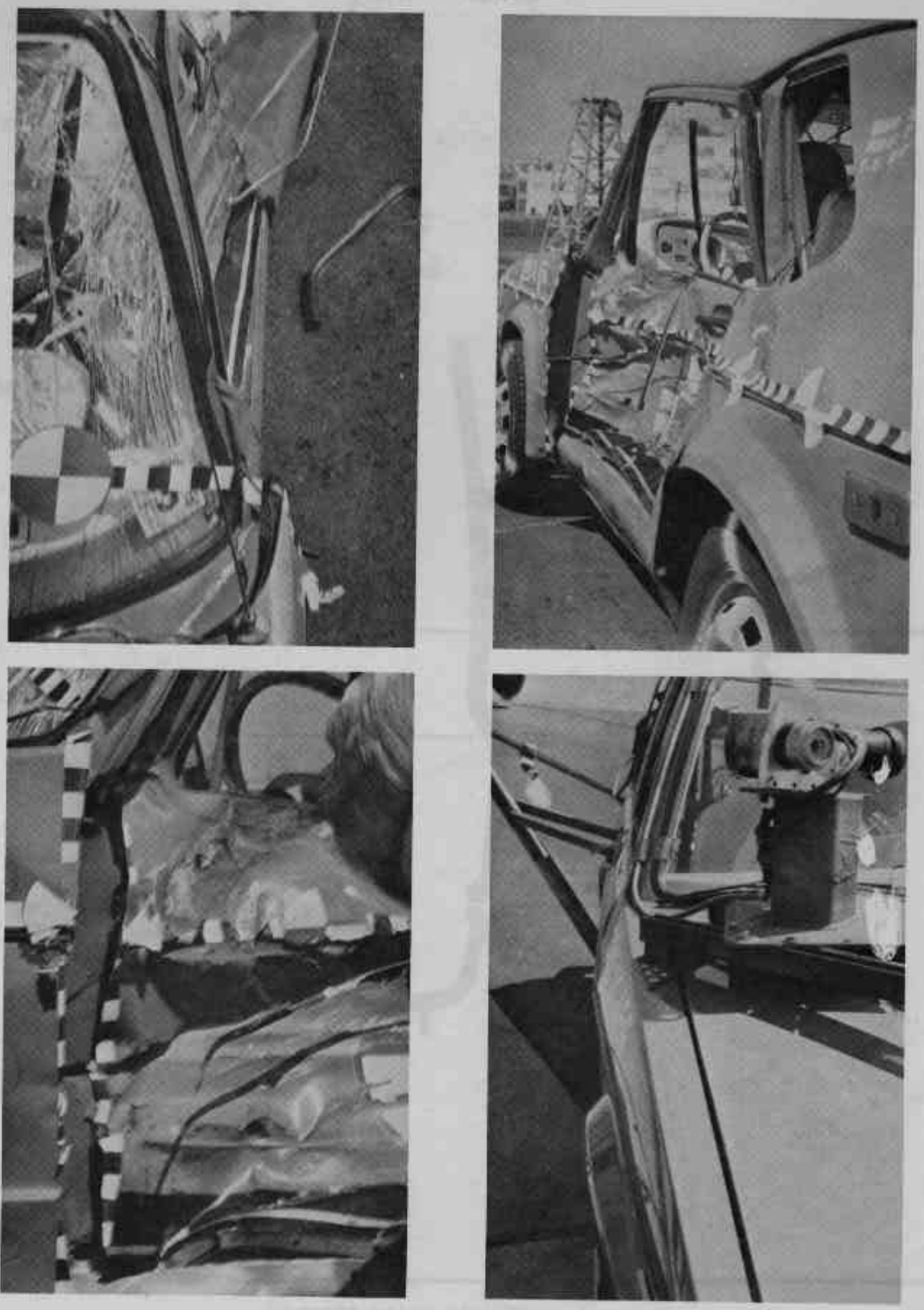


Figure 7 VW RABBIT POST-TEST EXTERIOR

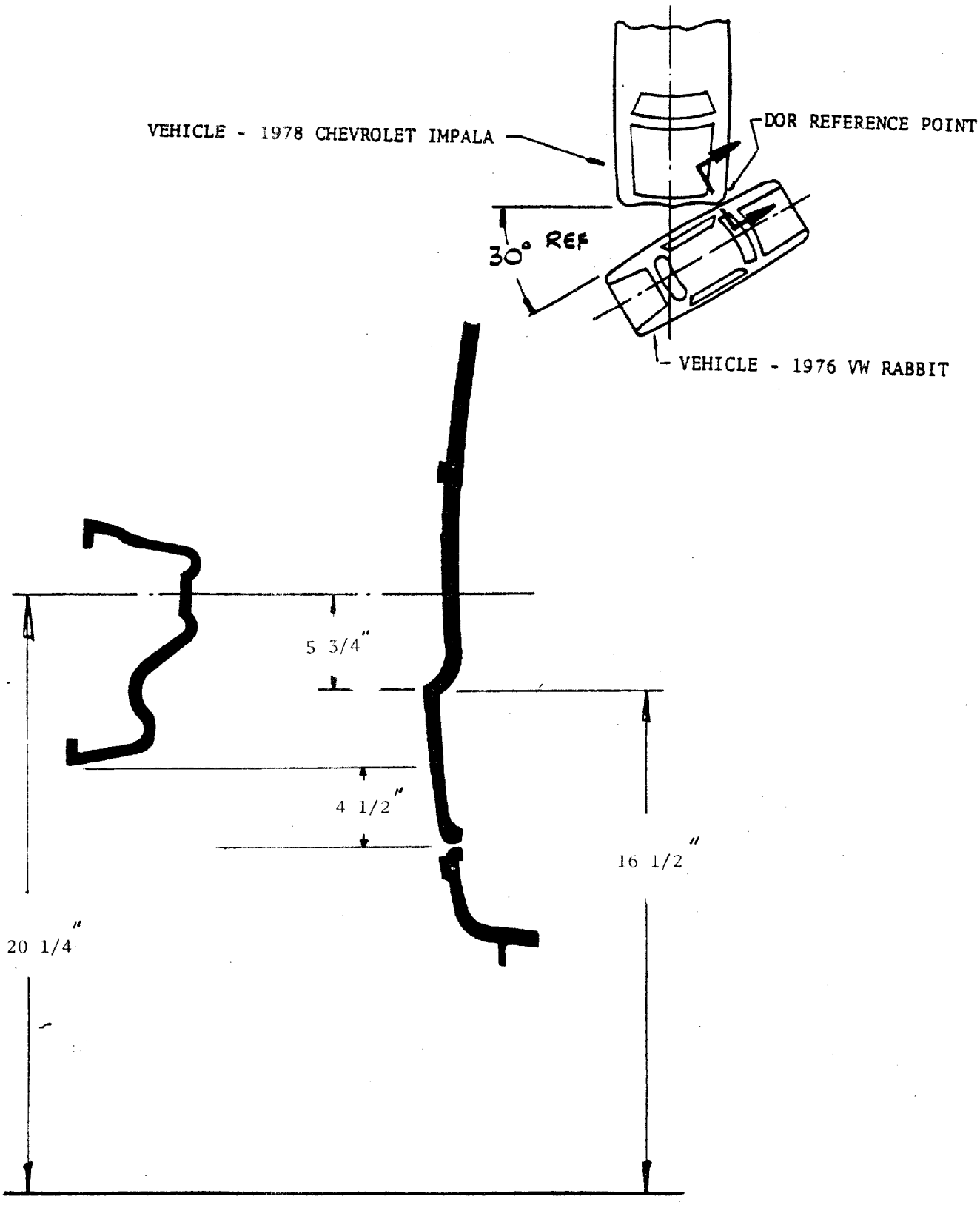
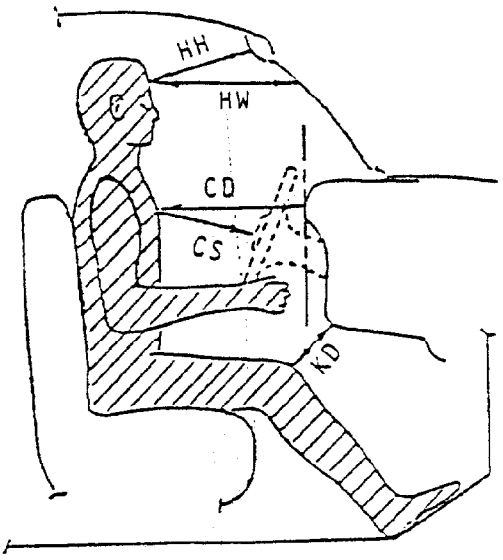


Figure 8 VEHICLE CRASH ATTITUDE

IMPALA	VW		
DR.		DRIVER	PASS
13 3/4"	HW	19"	18.75"
20"	HW	24 1/2"	23.5"
21 1/4"	CD	23"	22.5"
14 7/8"	CS	14 1/2"	-
7"	KDL	6 3/4"	6.88"
6 7/8"	KDR	6 1/2"	7.0"



IMPALA	VW		
DR.		DRIVER	PASS
6 1/2"	HR	5.0"	5.0"
10 3/4"	HS	6.5"	6.5"
5"	AD	4.5"	3.0"
6"	HD	6.0"	5.25"

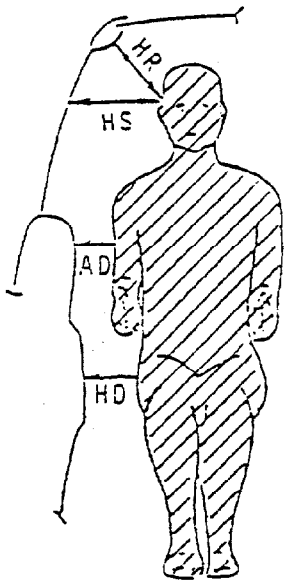


Figure 9 OCCUPANT CLEARANCE DIMENSIONS

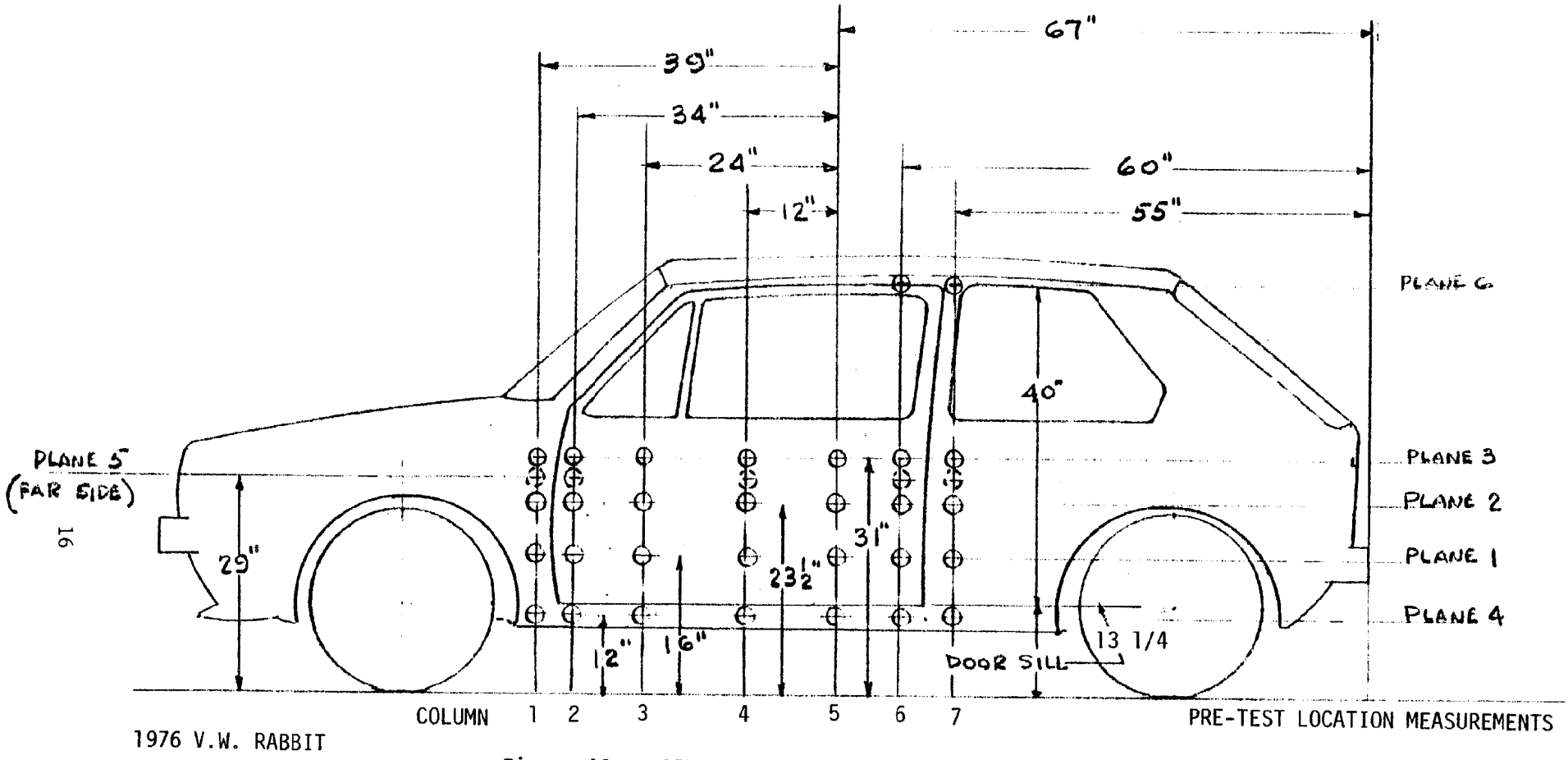


Figure 10 SIDE INTRUSION MEASUREMENT LOCATIONS

Table 3

SIDE INTRUSION MEASUREMENTS

DIMENSIONS LISTED BELOW ARE FROM POINTS SHOWN ON FIG. 10 TO REF. PLANES LOCATED PARALLEL TO AND OUTBOARD FROM ℄ OF VEHICLE (L. SIDE 34 " - R. SIDE 34 ")

DIMENSIONS (INCHES)

PLANE NO.		COLUMN 1	2	3	4	5	6	7
1	PRE	4 3/8	4 3/8	4 1/4	4 3/8	4 1/2	4 1/2	4 1/2
	POST	7 1/2	11 3/8	14 1/2	14 3/8	13 1/8	12 1/4	10 1/2
	DIFF.	3 1/8	7	10 1/4	10	8 5/8	7 3/4	6
2	PRE	3 5/8	3 3/4	3 5/8	3 5/8	3 5/8	3 3/4	3 3/4
	POST	7	14 3/8	17 5/8	17 3/4	15 1/2	13 7/8	12 3/4
	DIFF.	3 3/8	10 5/8	14	14 1/8	11 7/8	10 1/8	9
3	PRE	4 1/4	4 1/4	4	4	4	4	4
	POST	7 1/4	12 3/8	17 3/8	17 7/8	14 5/8	15 1/8	14 5/8
	DIFF.	3	8 1/8	13 3/8	13 7/8	10 5/8	11 1/8	10 5/8
4	PRE	5 3/8	5 5/8	5 5/8	5 5/8	5 3/4	6	6
	POST	7 3/8	10 1/2	10 3/4	10 5/8	10 3/8	10 1/8	9 1/8
	DIFF.	2	4 7/8	5 1/8	5	4 5/8	4 1/8	3 1/8
5	PRE	3 3/4	3 5/8	3 5/8	3 3/4	3 7/8	4	4
	POST	2 1/4	2 1/8	2 1/8	2 1/8	2 1/4	2 1/2	3
	DIFF.	1 1/2	1 1/2	1 1/2	1 5/8	1 5/8	1 1/2	1
6	PRE						11 3/4	11 3/4
	POST						13	14 1/2
	DIFF.						1 1/4	2 3/4
7	PRE							
	POST							
	DIFF.							

1976 VW RABBIT

BUDD DYNAMIC TEST NO. 14

Table 4

DOOR THICKNESS MEASUREMENTS

DIMENSIONS LISTED BELOW ARE MEASURED WITH A ROD THROUGH A 1/8" HOLE AT EACH LOCATION AS SHOWN IN FIGURE 10

PLANE NO.		THICKNESS (INCHES) ROW 2	3	4	5
1	PRE	3 1/2	3 3/8	3 1/2	2 3/4
	POST	1/2	2 3/16	1 1/2	2 1/4
	DIFF.	3	1 3/16	2	1/2
2	PRE	2 1/4	4	4 1/4	4 1/4
	POST	0	1/8	1/8	3/16
	DIFF.	2 1/4	3 7/8	4 1/8	4 1/16
3	PRE	3 1/2	3 3/8	3 1/2	2 3/4
	POST	5/16	1/4	5/8	1/8
	DIFF.	3 3/16	3 1/8	2 7/8	2 5/8

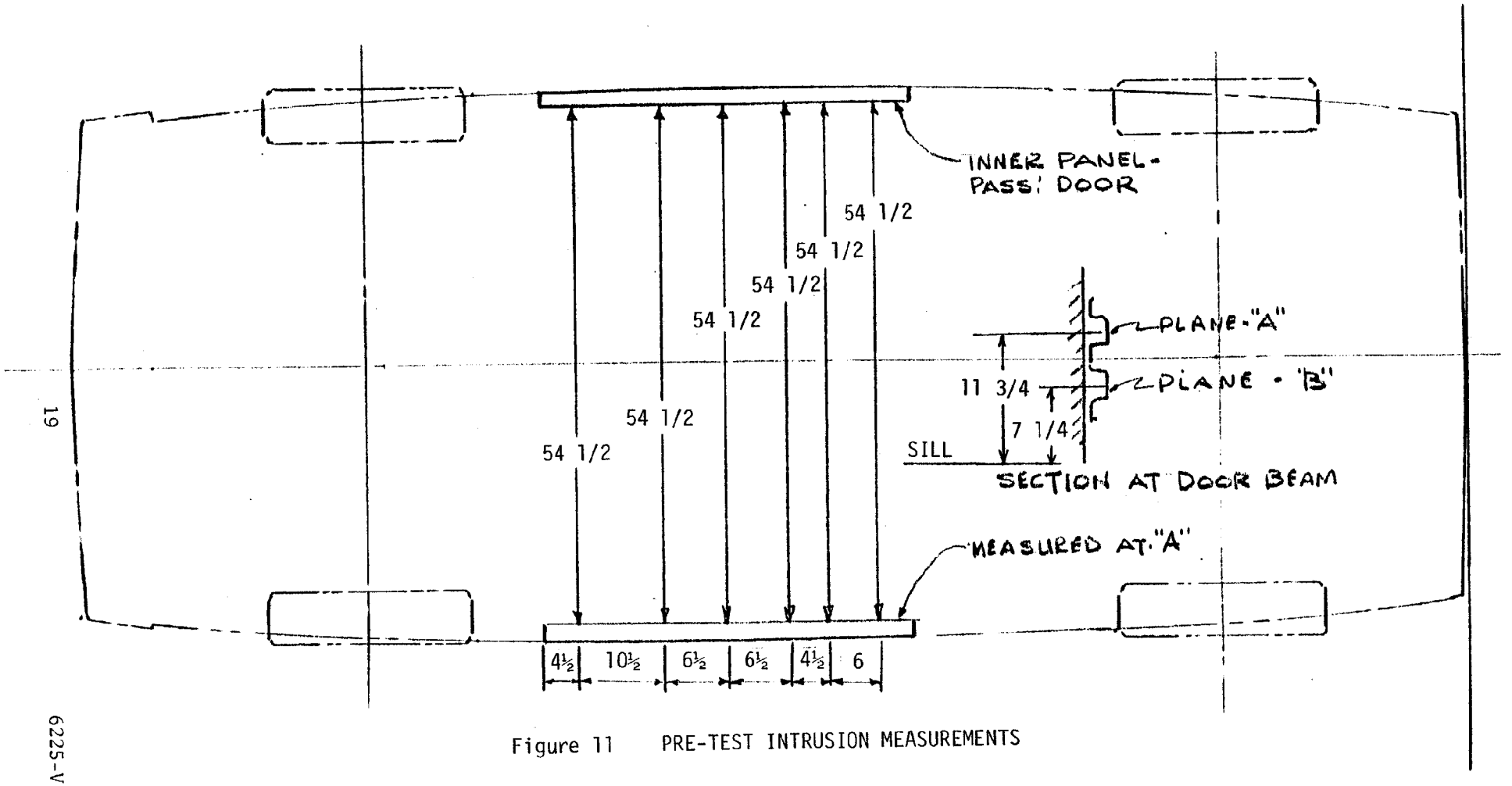


Figure 11 PRE-TEST INTRUSION MEASUREMENTS

6225-V-16

1976 V.W. RABBIT

PLANE "A"
PRE-TEST #14

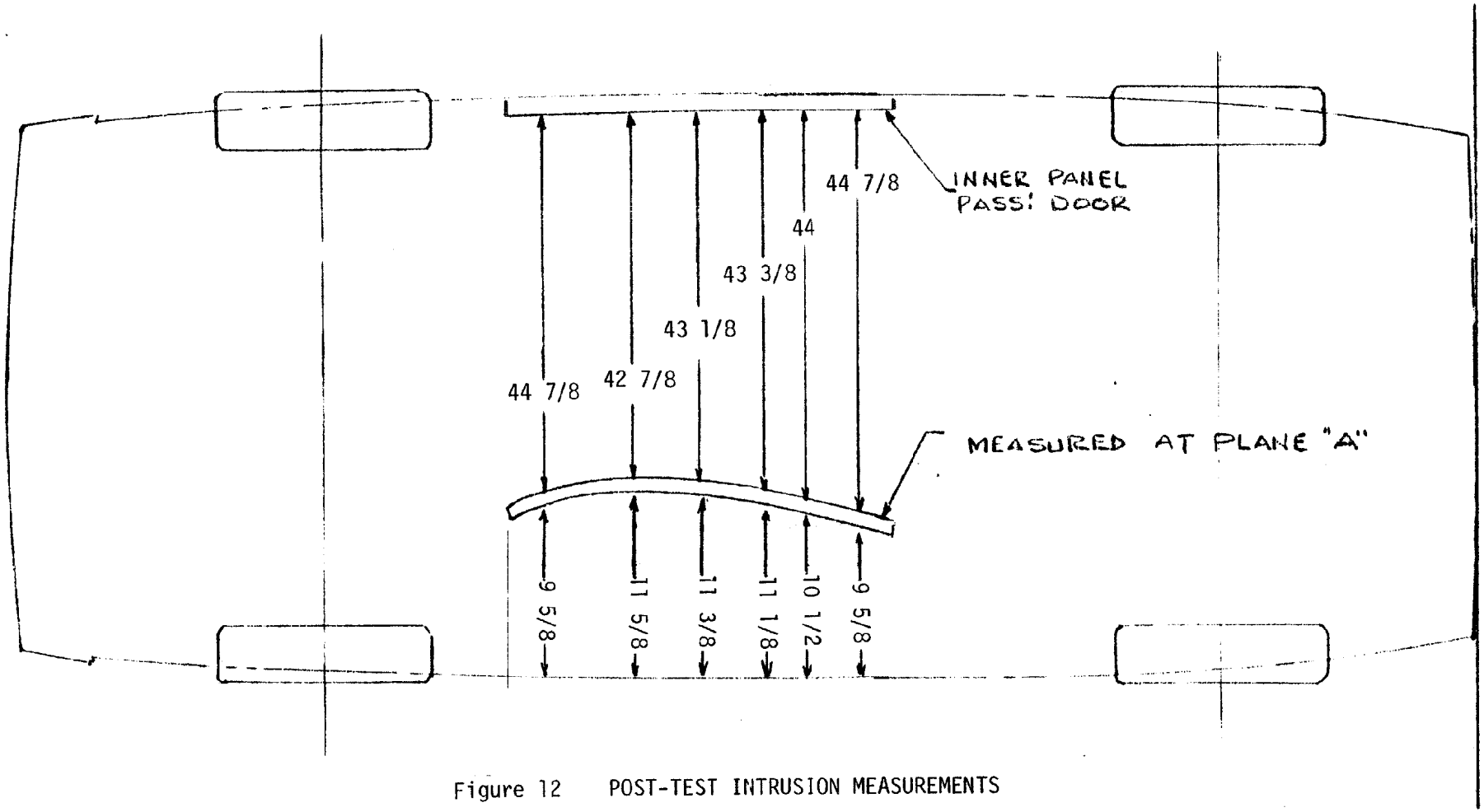


Figure 12 POST-TEST INTRUSION MEASUREMENTS

1976 V.W. RABBIT

PLANE "A"
POST-TEST #14

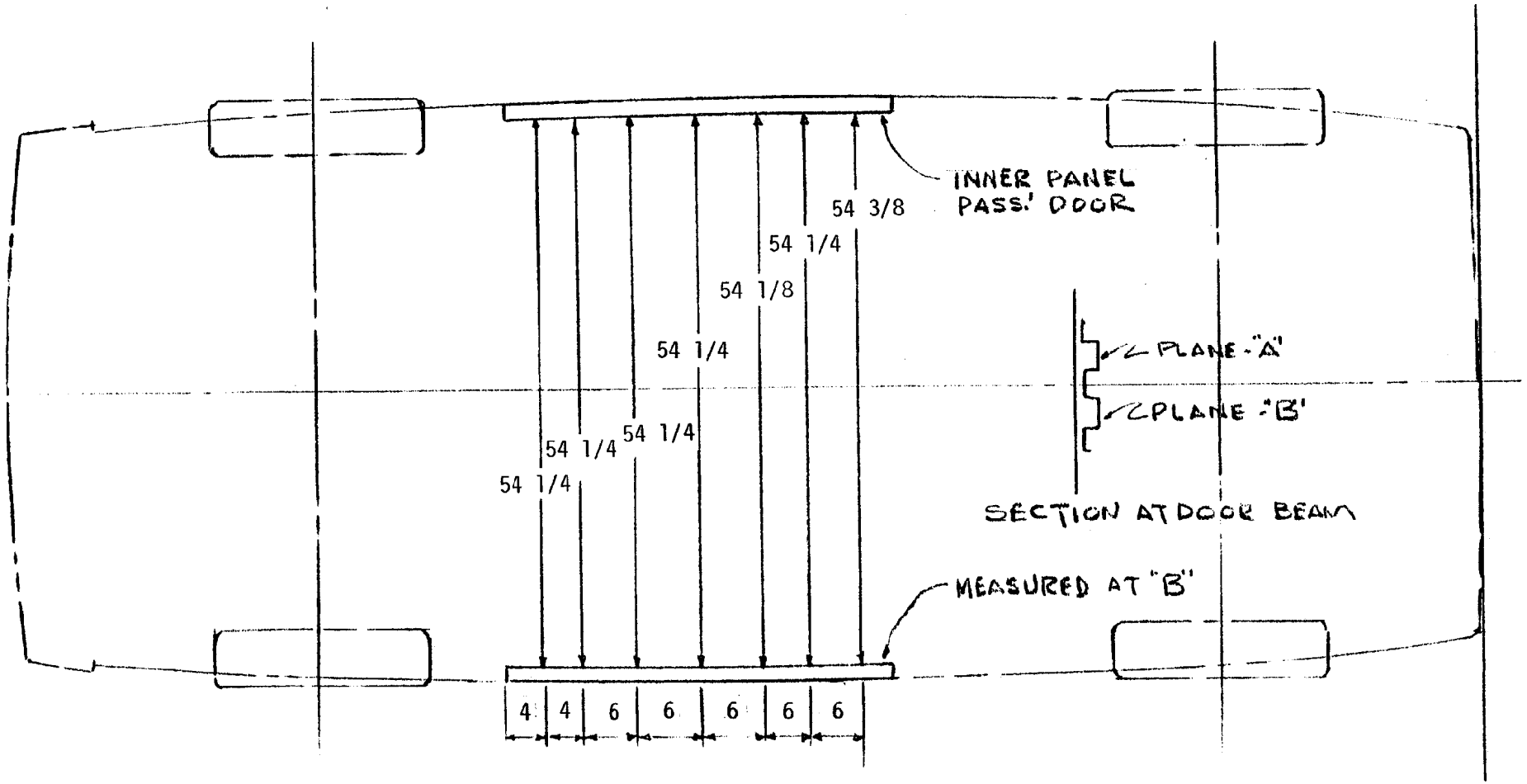


Figure 13 PRE-TEST INTRUSION MEASUREMENTS

1976 V.W. RABBIT

PLANE "B"
PRE-TEST #14

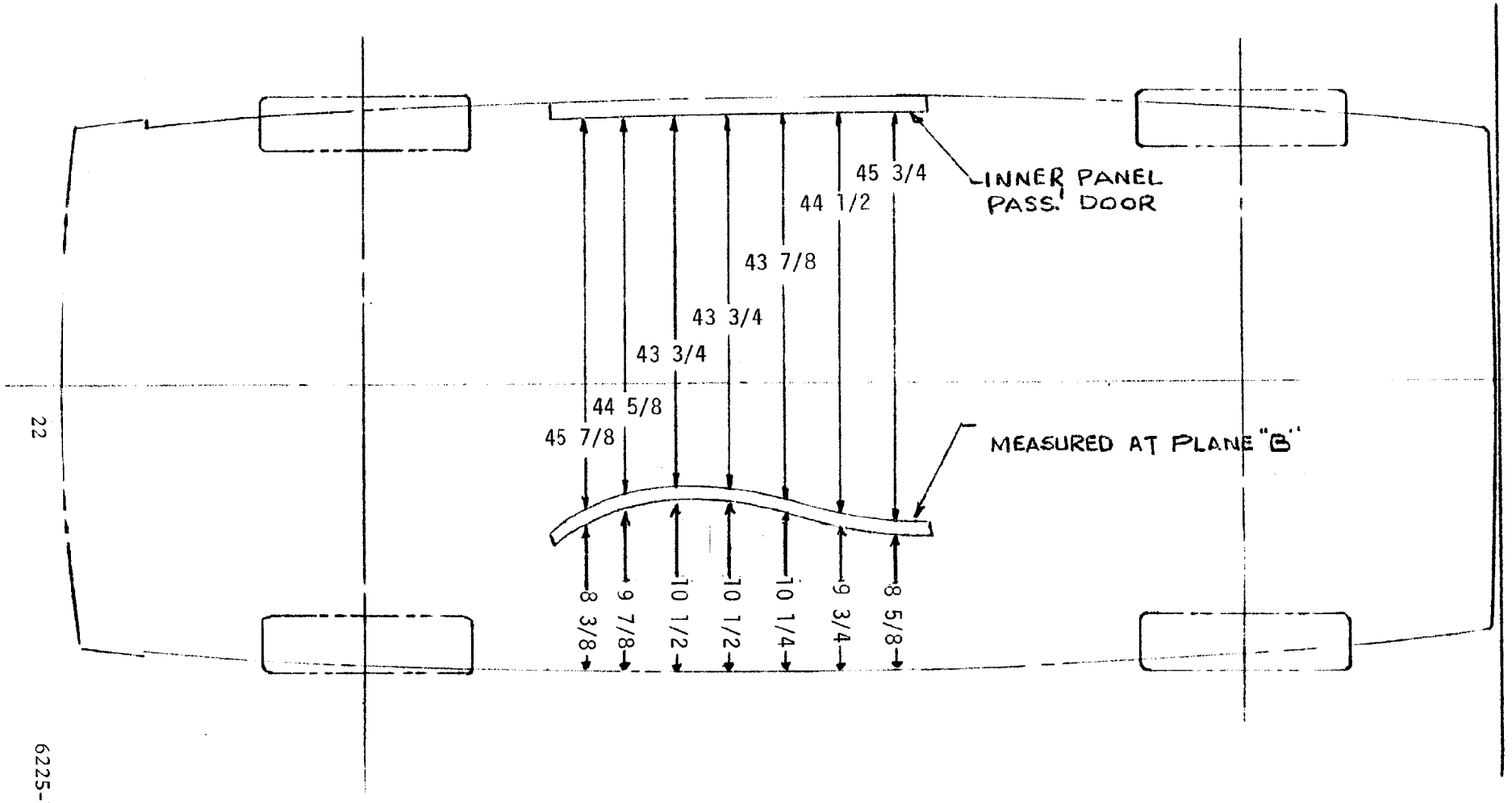


Figure 14 POST-TEST INTRUSION MEASUREMENTS

PLANE "B"
POST-TEST #14

1976 VW RABBIT

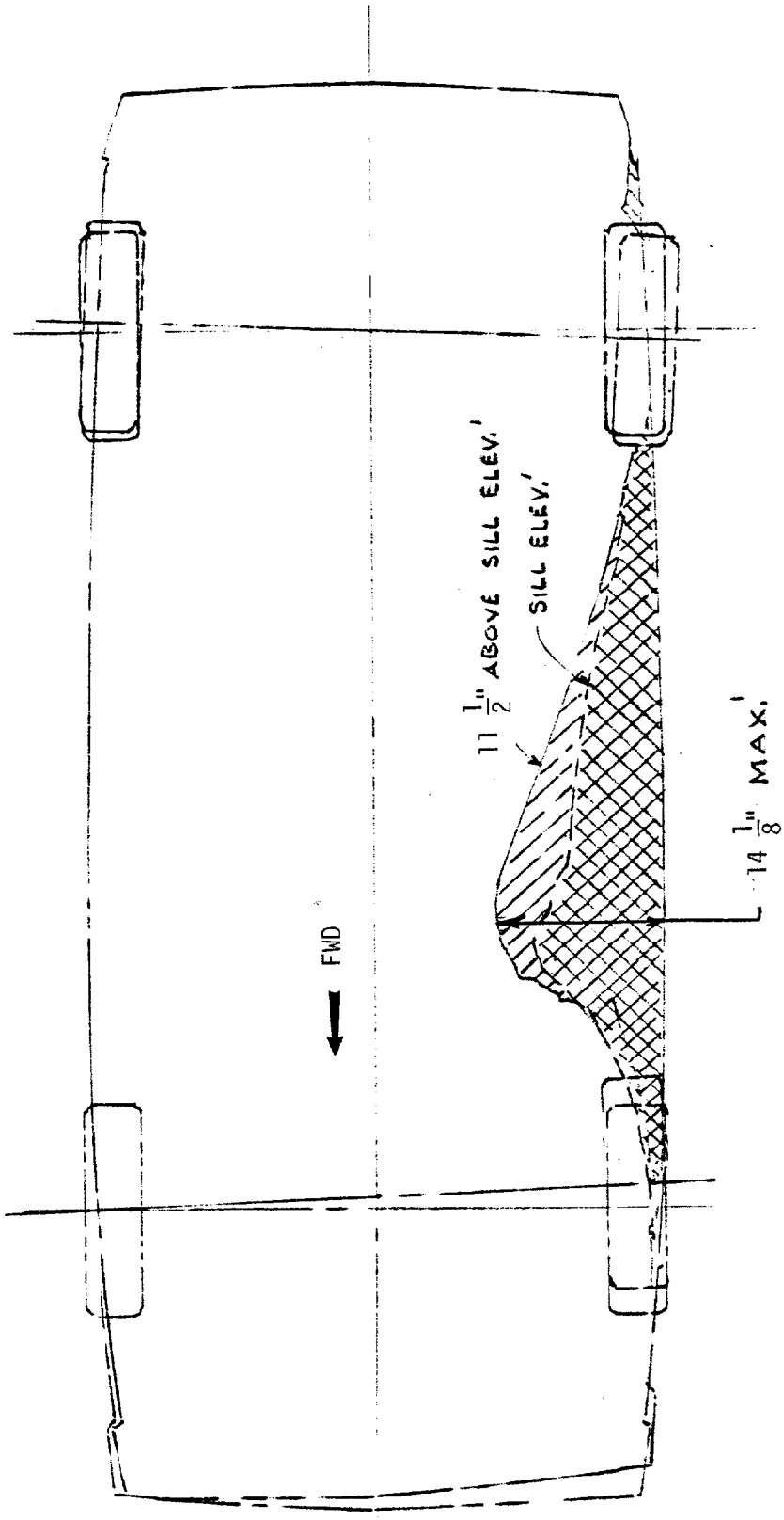


Figure 15 1976 VW RABBIT - EXTERIOR DEFORMATION

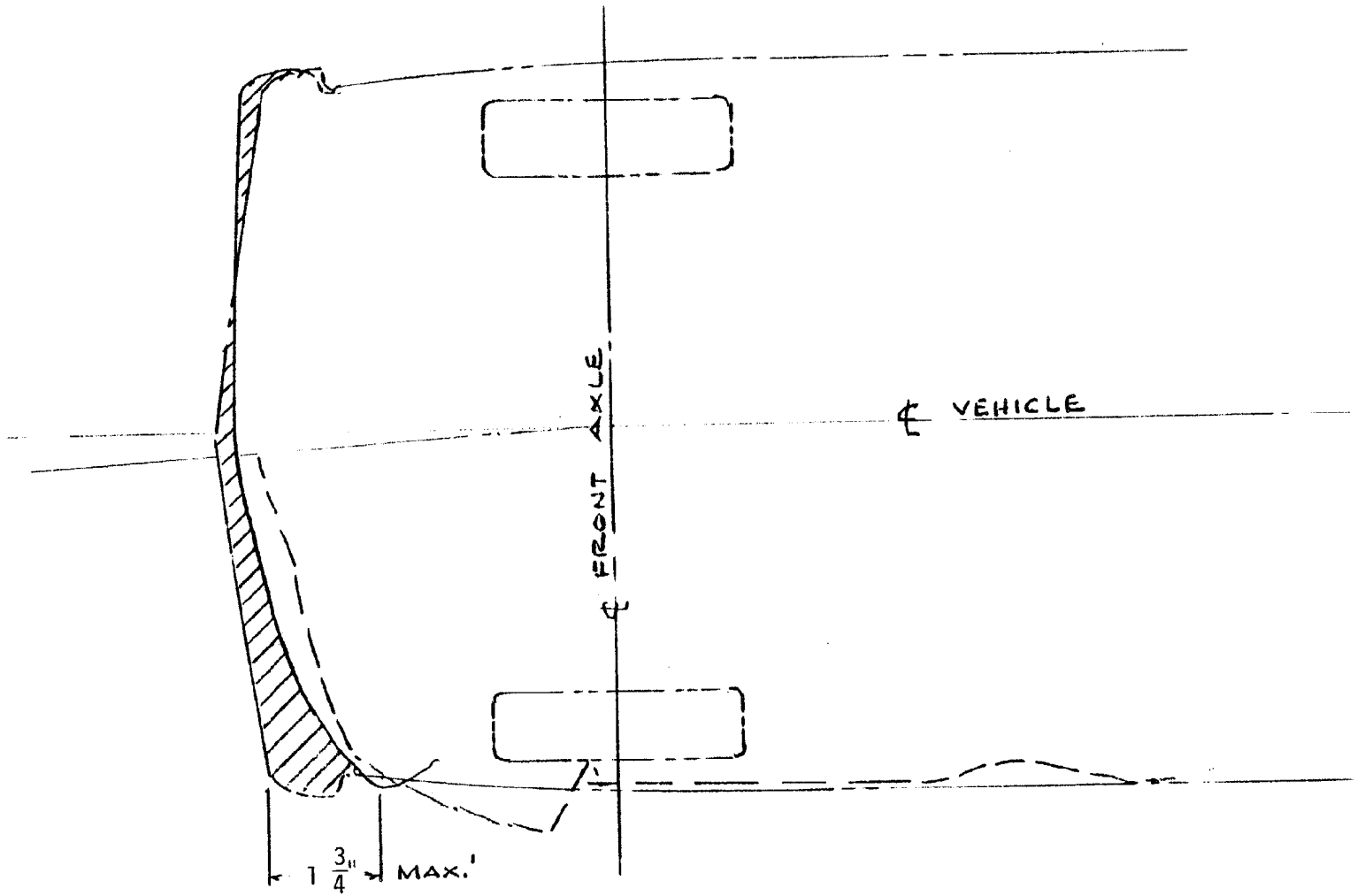


Figure 16 1978 CHEVROLET IMPALA - EXTERIOR DEFORMATION

TABLE 5

ELECTRONIC INSTRUMENTATION TEST NO. 13

Car 1 - Bullet Vehicle - 1978 Chevrolet Impala

TRANSDUCER DESCRIPTION OR ACCELEROMETER LOCATION *	DIRECTION OF PARAMETER BEING MEASURED	LOCATION ON VEHICLE	DESCRIPTION LISTED ON DATA PLOTS
VEHICLE ACCELEROMETER			
1	X	Left Sill next to rear seat	Left Compartment
2	X	Right Sill next to rear seat	Right Compartment
3	X, Y, Z	Deck over rear Axle	Rear deck
4	X, Y, Z	Firewall	Firewall
5	X	Rear Compartment	Left Rear Compartment - Angular X
6	X, Y, Z	Top of Engine, Carbureter	Engine
7	X	Front Crossmember	Front Crossmember
9	X	Rear Compartment	Right Rear Compartment - Angular X
DUMMY			
LF Head (Dummy(1))	X, Y, Z	Left Front Seat	Dummy (LF) Head
LF Chest "	X, Y, Z	Left Front Seat	Dummy (LF) Chest
LF Femurs "	R, L**	Left Front Seat	Dummy (LF) Femurs
LF Belts "	U, R, L***	Left Front Seat	Self-explanatory
MISCELLANEOUS			
10	Yaw Rate	Centerline behind Front Seats	Tunnel Yaw Rate
8	X-Accel.	Bumper (rear face)	Bumper

*See Accelerometer Layout Diagram Figure 13 **Right & Left Forces ***Upper, Lower Belt Forces

Car 1 - Bullet Vehicle - 1978 Chevrolet Impala

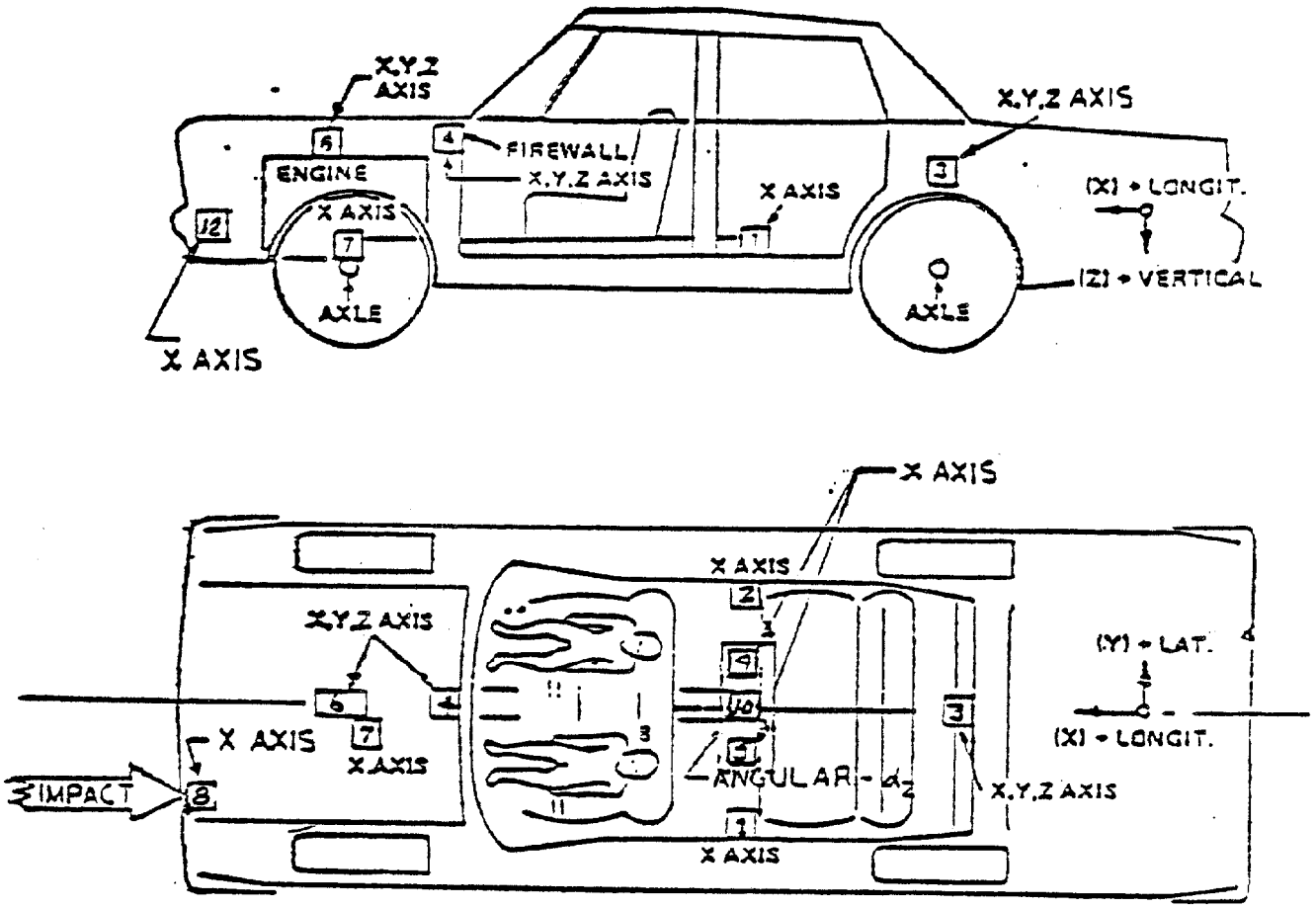


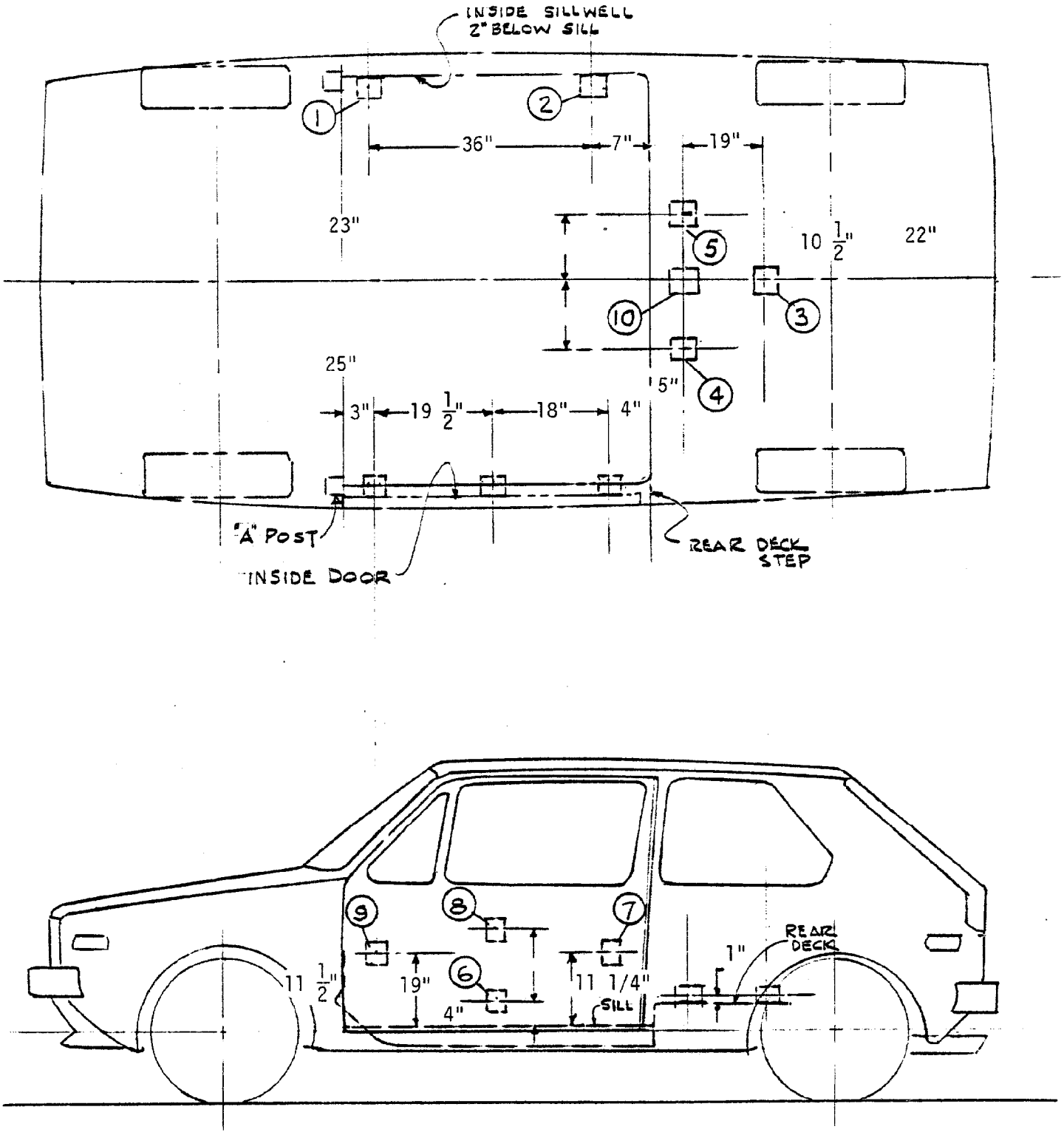
Figure 17 VEHICLE ACCELEROMETER LOCATIONS

Table 6

ELECTRONIC INSTRUMENTATION TEST NO. 13

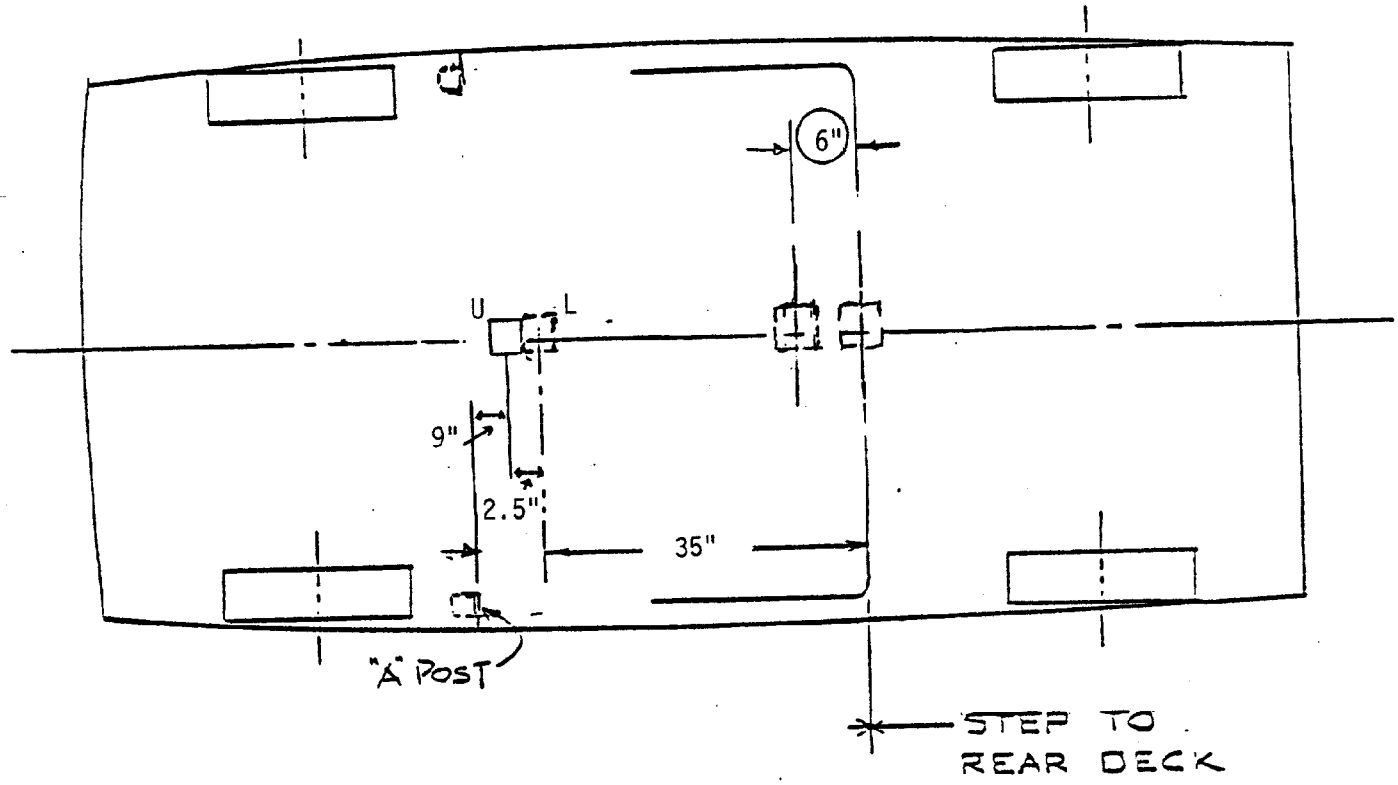
Car 2 - Target Vehicle - 1976 Volkswagen Rabbit

TRANSDUCER DESCRIPTION OR ACCELEROMETER LOCATION *	DIRECTION OF PARAMETER BEING MEASURED	LOCATION ON VEHICLE	DESCRIPTION LISTED ON DATA PLOTS
VEHICLE ACCELEROMETER			
1	X, Y, Z	Right Sill next to Front Seat	Right Front Compartment
2	X, Y, Z	Right Sill next to Rear Seat	Right Rear Compartment
3	X, Y, Z	Deck over Rear Axle	Rear Deck
4	X	Rear Compartment	Left Compartment-Angular X
5	X	Rear Compartment	Right Compartment-Angular X
6	Y	Lower Left Door Centerline	Lower Door Center
7	Y	Mid-rear of Left Door	Mid-aft of Door
8	Y	Upper Left Door Centerline	Upper Door Center
9	Y	Mid-Front of Left Door	Mid-front of Door
DUMMY			
LF Head (Dummy (1))	X, Y, Z	Left Front Seat	Dummy (LF) Head
LF Upper Spine (Dummy (1))	X, Y, Z	Left Front Seat	Upper Spine
LF Lower Spine (Dummy (1))	X, Y, Z	Left Front Seat	Lower Spine
LF Pelvis (Dummy (1))	X, Y	Left Front Seat	Pelvis
LF Upper Left Rib (Dummy (1))	Y	Left Front Seat	Upper Left Rib
LF Lower Left Rib (Dummy (1))	Y	Left Front Seat	Lower Left Rib
LF Upper Right Rib (Dummy (1))	Y	Left Front Seat	Upper Right Rib
LF Upper Sternum (Dummy (1))	X	Left Front Seat	Upper Front
LF Lower Sternum (Dummy (1))	X	Left Front Seat	Lower Front
LF Lower Right Rib (Dummy (1))	Y	Left Front Seat	Lower Right Rib
RF Head (Dummy (2))	X, Y, Z	Right Front Seat	Dummy (RF) Head
RF Chest (Dummy (2))	X, Y, Z	Right Front Seat	Dummy (RF) Chest
RF Pelvis (Dummy (2))	X, Y	Right Front Seat	Dummy (RF) Pelvis
MISCELLANEOUS			
10	Yaw Rate	Centerline behind Front Seats	Tunnel Yaw Rate
13-16	Side Intrusion	Side Intrusion (Driver Side)	Side Intrusion



CAR NO. 2 - TARGET VEHICLE - 1976 VOLKSWAGEN RABBIT

Figure 18 VEHICLE ACCELEROMETER LOCATIONS



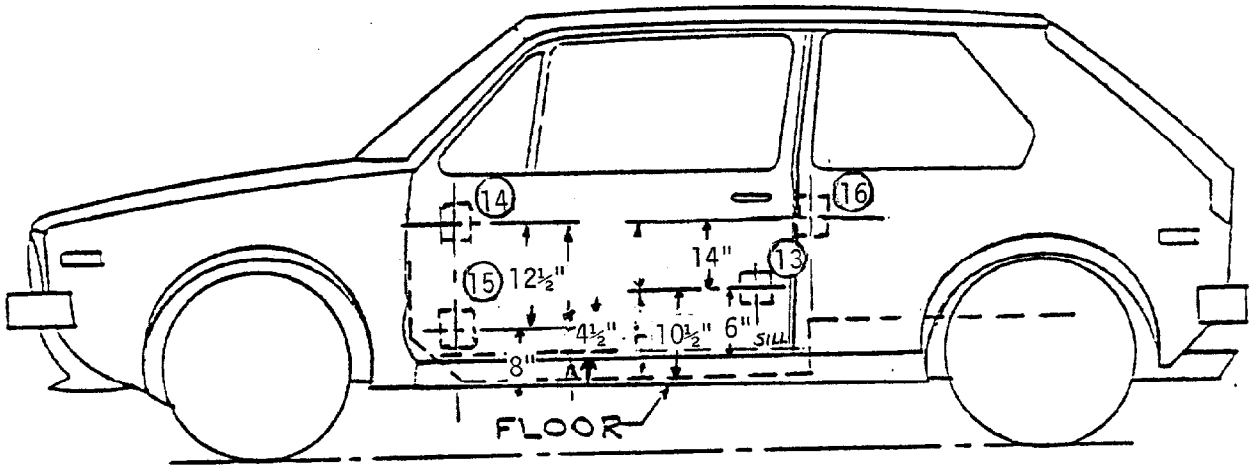


Figure 19 VEHICLE POTENTIOMETER LOCATIONS

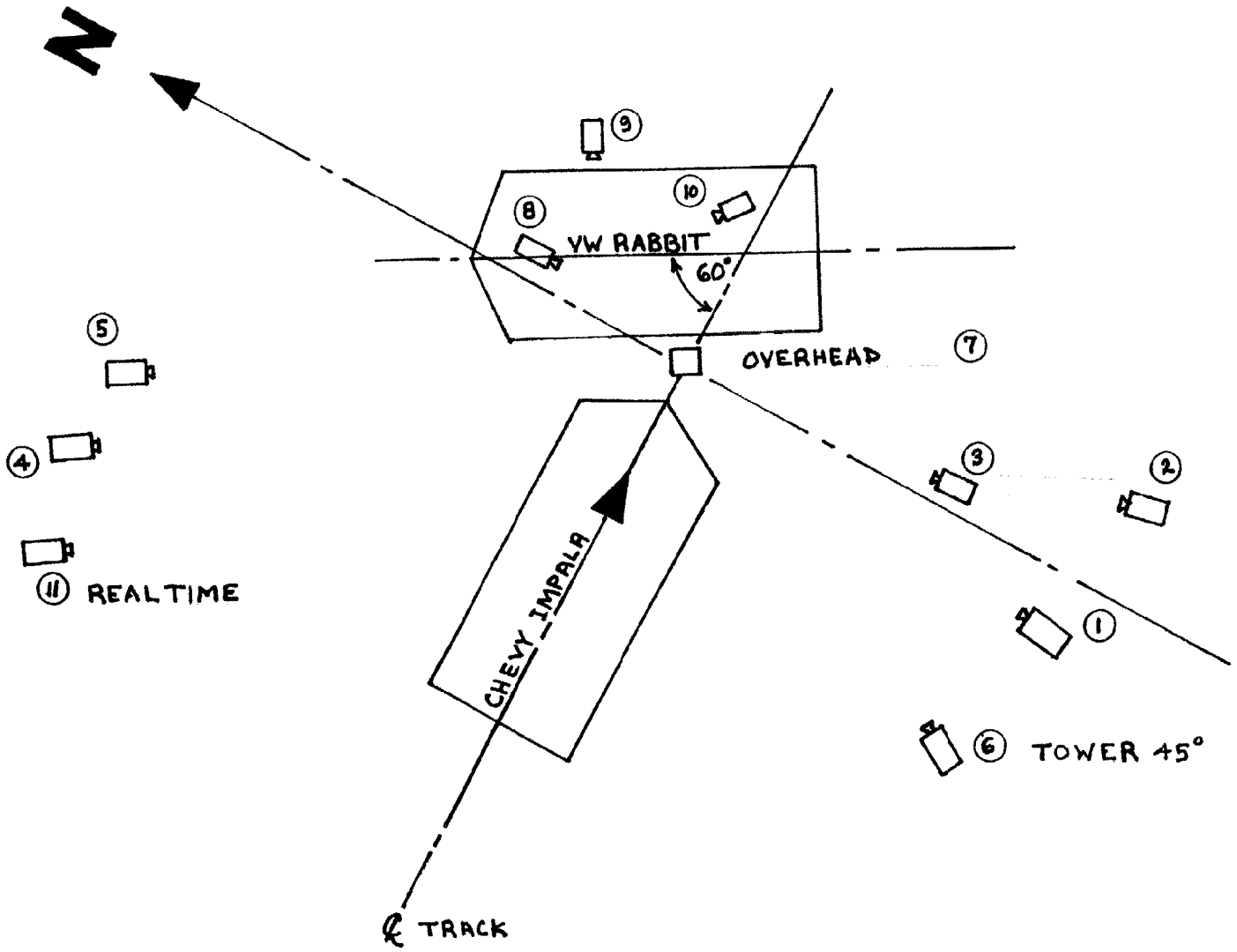


Figure 20 CAMERA POSITIONS

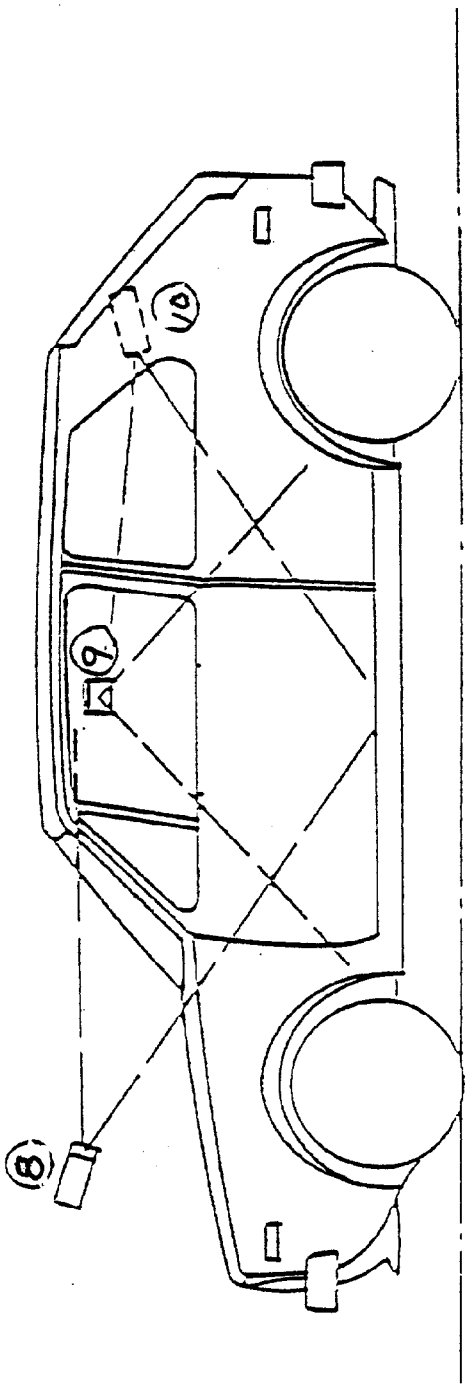


Figure 21 ON-BOARD HIGH SPEED CAMERA LOCATIONS

Table 7

HIGH SPEED CAMERA INFORMATION (TEST NO. 14)

CAMERA NO.	LOCATION	TYPE	SPEED (fps)
1	SOUTH WIDE	PHOTOSONIC	1030
2	SOUTH CLOSE	FASTAX	No Pulse
3	SOUTH LOW	FASTAX	1440
4	NORTH WIDE	FASTAX	No Pulse
5	NORTH CLOSE	FASTAX	1300
6	TOWER 45°	PHOTOSONIC	530
7	OVERHEAD	PHOTOSONIC	1000
8	ON-BOARD HOOD	STALEX	630
9	ON-BOARD DOOR	STALEX	800
10	ON-BOARD REAR	STALEX	710
11	NORTH WIDE	REAL TIME	24

NOTE: CAMERAS ARE NUMBERED ACCORDING TO SPLICING SEQUENCE OF FILM AND AS SHOWN IN FIGURES 20 AND 21.

(24 fps) REAL TIME MOVIE FILM COVERAGE OF PRE-CRASH, POST-CRASH AND CRASH EVENT SPLICED AT START AND END OF FILM.

Table 8

DUMMY INJURY CRITERIA VALUES

CAR 1 - STRIKING VEHICLE

	MAXIMUM ACCELERATION ("G") *											
	HEAD				CHEST				PELVIS			
	X	Y	Z	R	X	Y	Z	R	X	Y	Z	R
DUMMY (1)	-18	4	13	18.5	-13	5	-4	13	-	-	-	-
DUMMY (2)												
DUMMY (3)												
DUMMY (4)												

	MAXIMUM FORCE-FEMUR LOAD (LBS)	
	RIGHT FEMUR	LEFT FEMUR
DUMMY (1)	70	190
DUMMY (2)		
DUMMY (3)		
DUMMY (4)		

	MAXIMUM FORCE-SEAT BELTS LOADS (LBS)		
	SHOULDER STRAP UPPER BELT LOAD	LAP STRAP RIGHT BELT LOAD	LAP STRAP LEFT BELT LOAD
DUMMY (1)	555	N.G.	230
DUMMY (2)			
DUMMY (3)			
DUMMY (4)			

	HEAD INJURY CRITERIA**				SEVERITY INDEX	
	HIC	t_1 (SEC)	t_2 (SEC)	AVE. ACC. (g) t_1 TO t_2	HEAD	CHEST
DUMMY (1)	61	.10230	.16410	15.7	70	
DUMMY (2)						
DUMMY (3)						
DUMMY (4)						

*DEFINED AS EXCEEDING 0.003 SEC. DURATION

**AS DEFINED IN FMVSS NO. 208

Table 9

DUMMY INJURY CRITERIA VALUES

CAR 2 - STRUCK VEHICLE

	MAXIMUM ACCELERATION ("G") *											
	HEAD				CHEST				PELVIS			
	X	Y	Z	R	X	Y	Z	R	X	Y	Z	R
DUMMY (1)	-33	96	-60	104	***	***	***	***	-22	70	-	-
DUMMY (2)	-7	24	16	25	-8	52	-11	54	-16	72	-	-
DUMMY (3)												
DUMMY (4)												

	MAXIMUM FORCE-FEMUR LOAD (LBS)	
	RIGHT FEMUR	LEFT FEMUR
DUMMY (1)	-	-
DUMMY (2)	-	-
DUMMY (3)		
DUMMY (4)		

	MAXIMUM FORCE-SEAT BELTS LOADS (LBS)		
	SHOULDER STRAP UPPER BELT LOAD	LAP STRAP RIGHT BELT LOAD	LAP STRAP LEFT BELT LOAD
DUMMY (1)	-	-	-
DUMMY (2)	-	-	-
DUMMY (3)			
DUMMY (4)			

	HEAD INJURY CRITERIA**				SEVERITY INDEX	
	HIC	t_1 (SEC)	t_2 (SEC)	AVE. ACC. (g) t_1 TO t_2	HEAD	CHEST
DUMMY (1)	1299	.07050	.1110	63.5	1669	-
DUMMY (2)	79	.09390	.14940	18.2	108	-
DUMMY (3)						
DUMMY (4)						

*DEFINED AS EXCEEDING 0.003 SEC. DURATION

**AS DEFINED IN FMVSS NO. 208

*** SIDE IMPACT DUMMY HAS 12 CHEST ACCELEROMETERS

GENERAL COMMENTS ON SIDE IMPACTS

Table 10 summarizes the six 30 MPH side impact tests performed in this program to date. These tests are of identical mode and are listed in order of increasing side structure stiffness. The table lists struck vehicle and occupant lateral velocities at the time of occupant/door impact with the intent of reviewing the effect of side structure stiffness on the occupant. In addition the velocity change of the striking vehicle and the final struck vehicle maximum exterior deformation are listed.

The tabulated data clearly indicate the characteristics being sought. The struck vehicle velocity increases with side structure stiffness while exterior deformation and striking vehicle velocity both decrease. This trend is remarkably consistent except for test 14. As was noted earlier, the B-pillar in Test 14 buckled at mid-height in an unanticipated manner which apparently degraded the performance of the structure. The initial light and medium weight modifications, tests 5 and 10, were both judged unacceptable by the Budd Co. and were redesigned. This redesign improved their performance as is shown by the results of tests 7 and 11, respectively. A redesign of the heavyweight modification of test 14 is presently being performed by the Budd Co.

Column 3 of the table lists struck door inner panel velocity at the time of occupant impact. The trend that occurred in the vehicular data is not evident in this door data and there appears to be two anamolies. (The inner door panel velocity is higher in each of the modified vehicles than in the baseline and the inner door velocity remains nearly constant for the modified vehicles.)

The first anamoly can be explained by noting that the modifications include an inner door beam that is thicker than the production component. This modified door beam reduces the free space between the inner and outer door panels causing the velocity of the inner panel to more quickly increase to nearly that of the striking vehicle.

Table 10

MODIFIED VW RABBIT SIDE STRUCTURE
COMPONENT VELOCITY SUMMARY

1	2	3	4	5	6	7	8	9
Test No.	Description	Inner Door (MPH)	Struck Car (MPH)	Inner Door W/R Struck Car (MPH)	Max. Pelvis (MPH)	Max. Chest (MPH)	Struck Car Max. Deformation (in)	Striking Car Change (MPH)
1	Baseline	17 @ 38 msec	2.4 @ 38 msec	14.6	28 @ 65 msec	22 @ 77 msec	21"	-2 @ 38 msec
5	Lightweight MOD	23 @ 36 msec	3.1 @ 36 msec	19.9	29 @ 75 msec	24.5 @ 72 msec	20.4"	-2 @ 36 msec
7	Improved Lightweight MOD	26 @ 39 msec	4.5 @ 39 msec	21.5	27 @ 62 msec*	23 @ 75 msec*	15.8"	-3 @ 39 msec
10	Medium Weight MOD	23 @ 43 msec	5.5 @ 43 msec	17.5	27 @ 77 msec	23 @ 73 msec	14.1"	-3 @ 43 msec
11	Improved Medium Weight MOD	24 @ 44 msec	6.8 @ 44 msec	17.2	24 @ 75 msec	21 @ 73 msec	12.4"	-3.2 @ 44 msec
14	Heavyweight MOD	25.6 @ 42 msec	5.0 @ 42 msec	20.6	26.5 @ 80 msec**	27.5 @ 88 msec**	14.1"	-2.8 @ 42 msec

*OCCUPANT IN TEST #7 WAS RESTRAINED BY 3-POINT BELT.

**OCCUPANT WAS THE SIDE IMPACT DUMMY.

The second anamoly can be more easily understood by examining the inner door velocity with respect to the struck vehicle as shown in column 5 of the table. The door relative velocity of the modified vehicles decreases with increasing side structure stiffness. It is also interesting to note that this decrease in relative velocity is accomplished by a delay in the time for the door to impact the occupant. However, the corresponding velocity increase of the struck vehicle, shown in column 4, causes the velocity at which the door contacts the occupant to remain constant.

Columns 6 and 7 are maximum occupant pelvis and chest lateral velocities. A trend of decreasing maximum velocity in the pelvis is evident although somewhat questionable due to the small differences. A similar trend does not appear in the chest velocities. The test data show that the pelvis develops a greater velocity than the chest causing the occupant to "lean" toward the struck side. Films show this same behavior and, in fact, show the head passing through the window and striking the hood of the impacting vehicle. This "lean" and the resulting continuous contact with the door probably affects chest motion significantly. Looking at the occupant data more closely reveals another interesting point. Despite a lower inner door velocity at the time of occupant impact in the baseline test, the corresponding pelvis and chest maximum velocities are higher than those attained in the stiffest of the modified vehicles (Test 11). Undoubtedly this is because the striking vehicle is "pushing" the door and the occupant for a longer time and over a greater distance as indicated by the larger maximum exterior deformation recorded in the baseline test. The collision between the occupant and the inner door causes a sudden decrease in the measured inner door velocity. This decrease may be a local effect in the area of the transducer and thus not be representative of the true door motion. This effect makes it difficult to assess the influence of intrusion after contact.

Several conclusions concerning the occupant behavior can be drawn from the review of the data:

1. The occupant is insensitive to gross changes in side structure stiffness.

2. In spite of improvements to the side structure resulting in decreased intrusion the occupant is still struck by the intruding door while it is travelling at high velocity. Since it does not appear that this can be prevented within the constraints of this program attention should be focused on reducing the effects of the inevitable collision.

3. The effect of the intruding door on the occupant after contact is not clear.

4. The effect of door kinematics on the occupant are not fully understood. Perhaps if the door could be made to contact the occupant uniformly from shoulder to hip performance would improve.

5. In general it would appear that stiffening of the side structure should take place on the outer skin of the struck door with as much space as possible between the outer and inner door surfaces. A maximum amount of energy can then be absorbed before intrusion begins. This is exactly the approach being followed in this program with the stiffened VW Rabbit door beam being attached to the outer door skin. Unfortunately, the interior door space is so small that virtually no delay occurs between outer and inner door motion. A substantial improvement in occupant performance might be realized if the inner door panel could be modified such that it is adjacent to the seated occupant thus increasing the interior door space and removing the free space between the vehicle and occupant. This would cause the occupant to accelerate with the struck vehicle and the striking velocity with respect to the occupant to be the relative velocity of column 5 in Table 10.

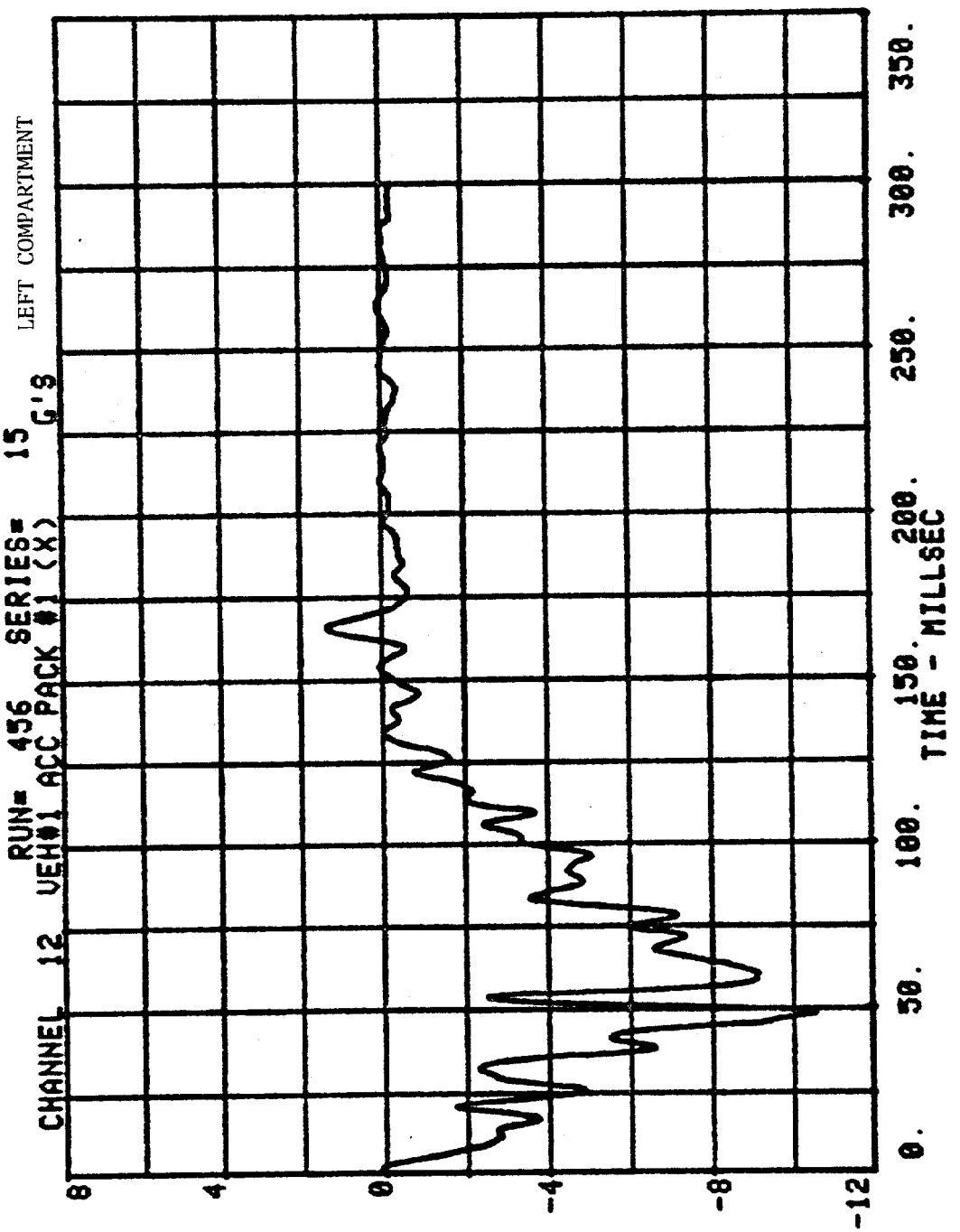
APPENDIX A

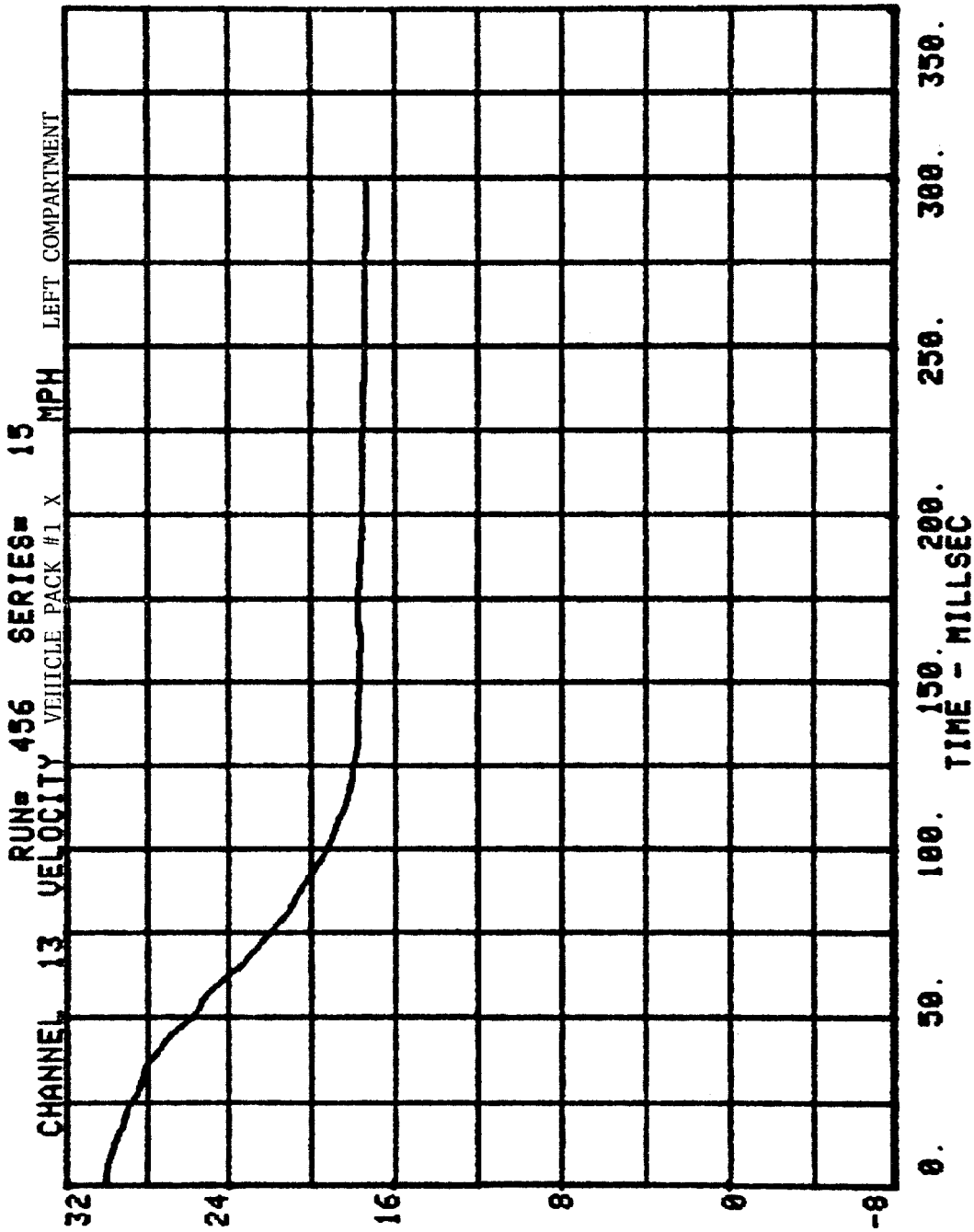
VEHICLE AND DUMMY DATA

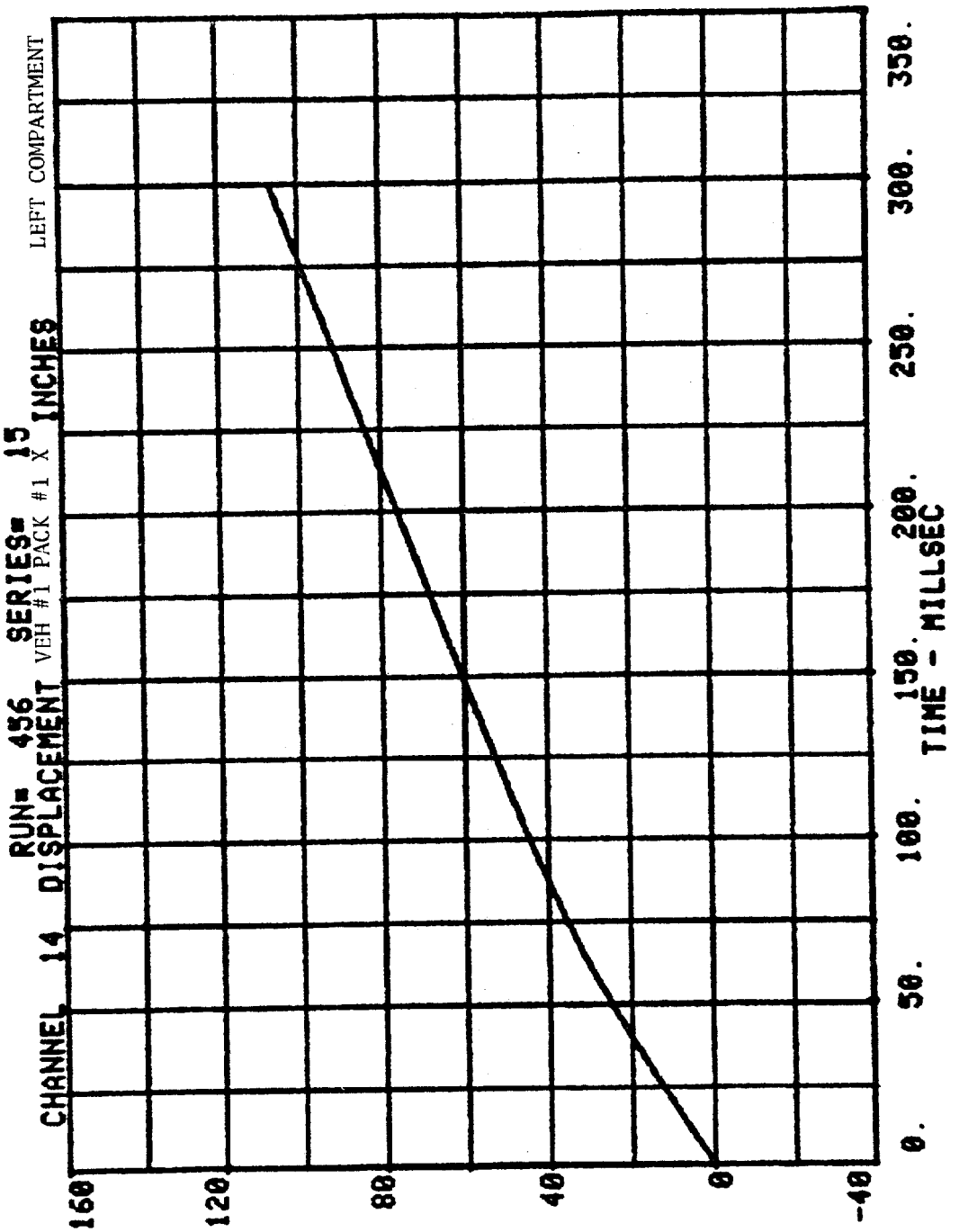
TEST NO. 14

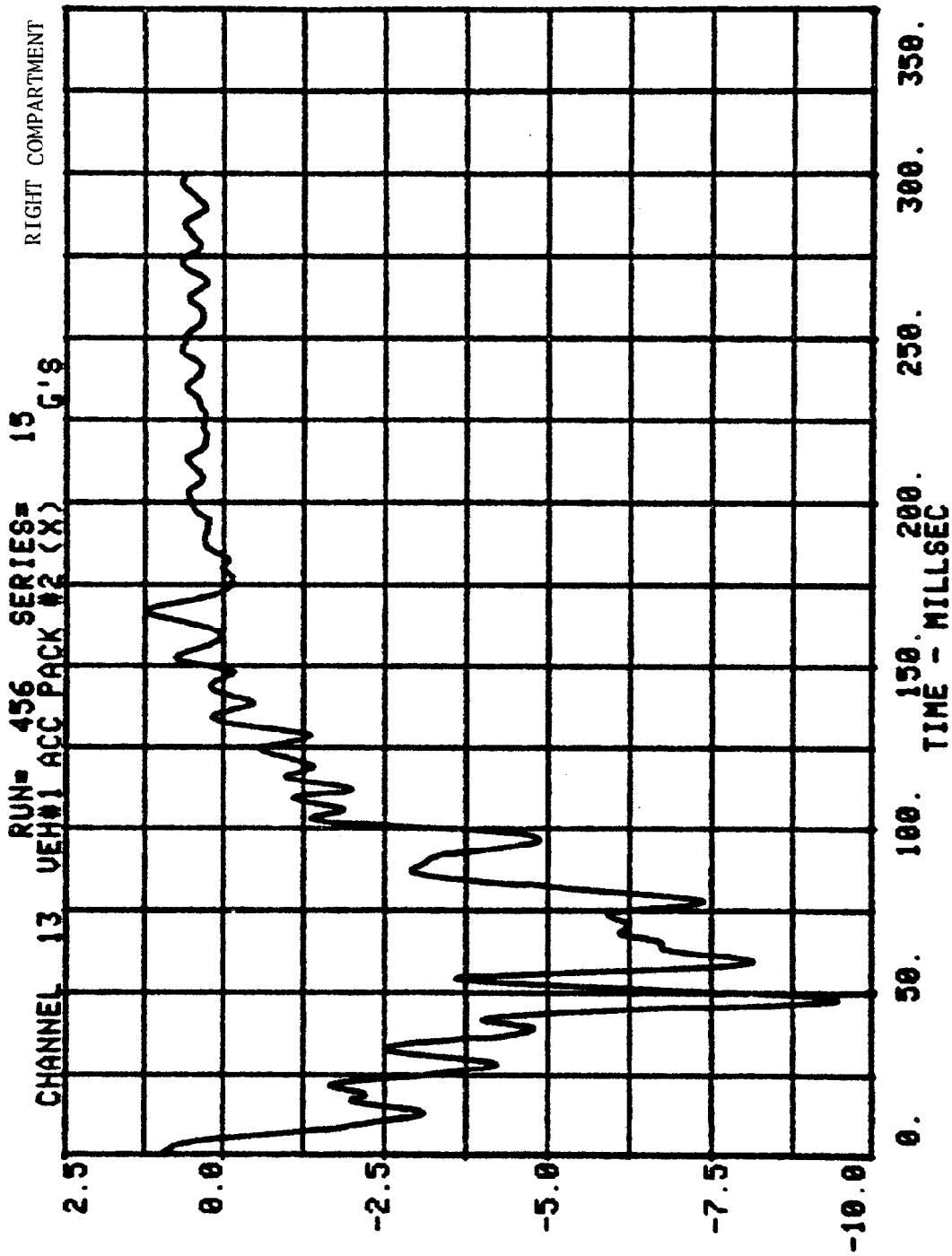
VEHICLE NO. 1 - 1978 CHEVROLET IMPALA

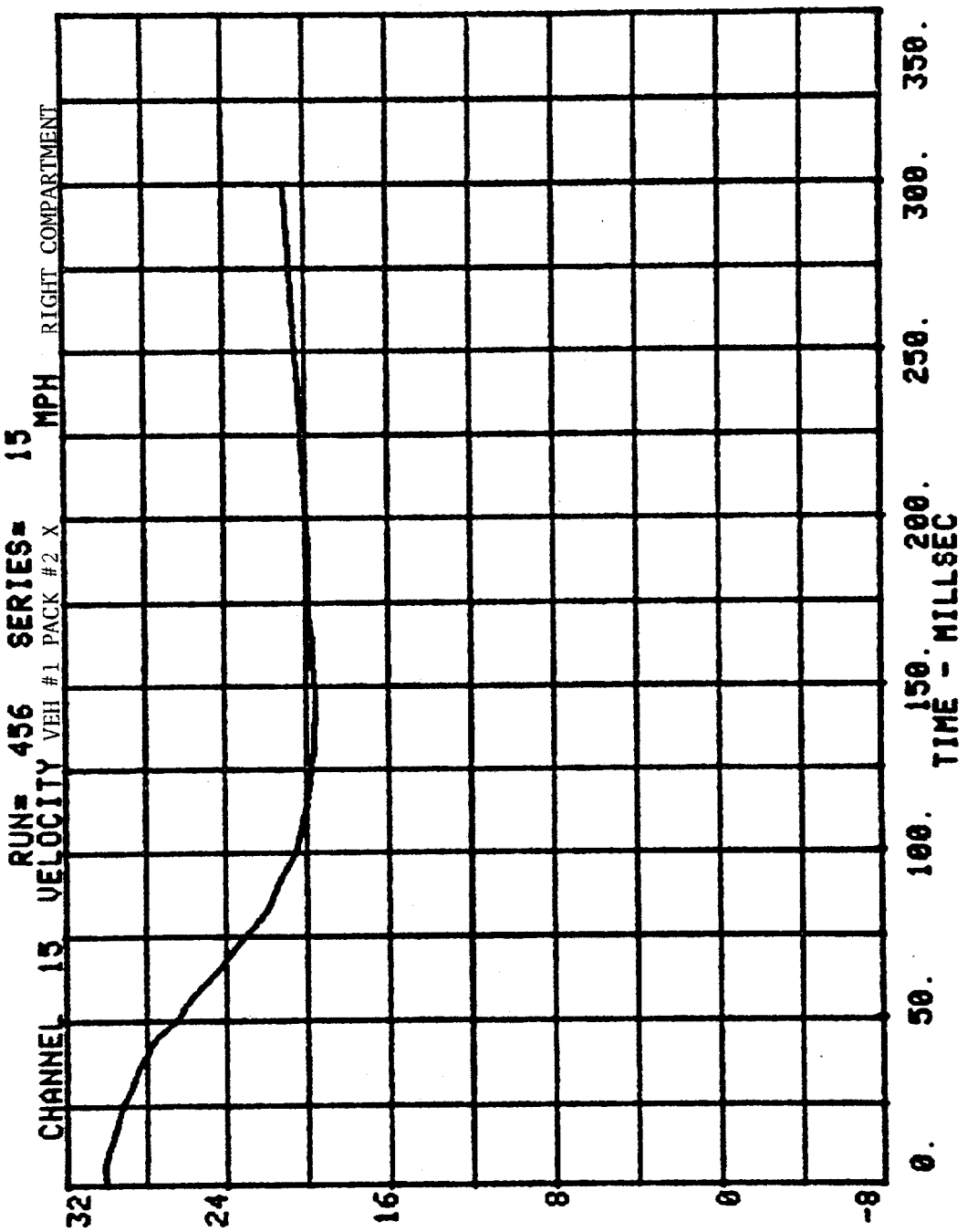
	Channel Filter Class
Accelerations	60 Hz

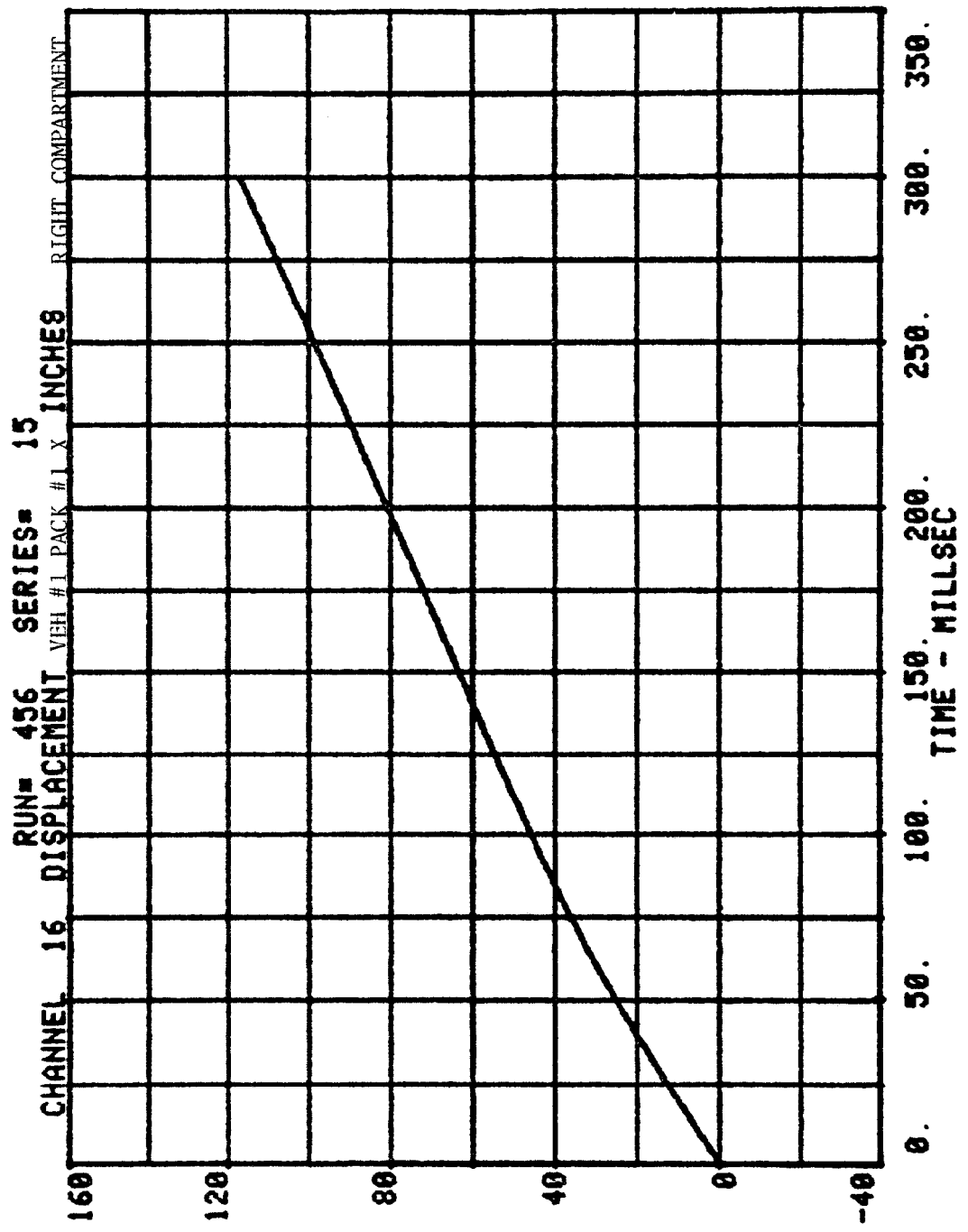

CHANNEL 12 VEH#1 ACC PACK #1 (X)
RUN= 456 SERIES= 15
G'S
LEFT COMPARTMENT
8
4
0
-4
-8
-12
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

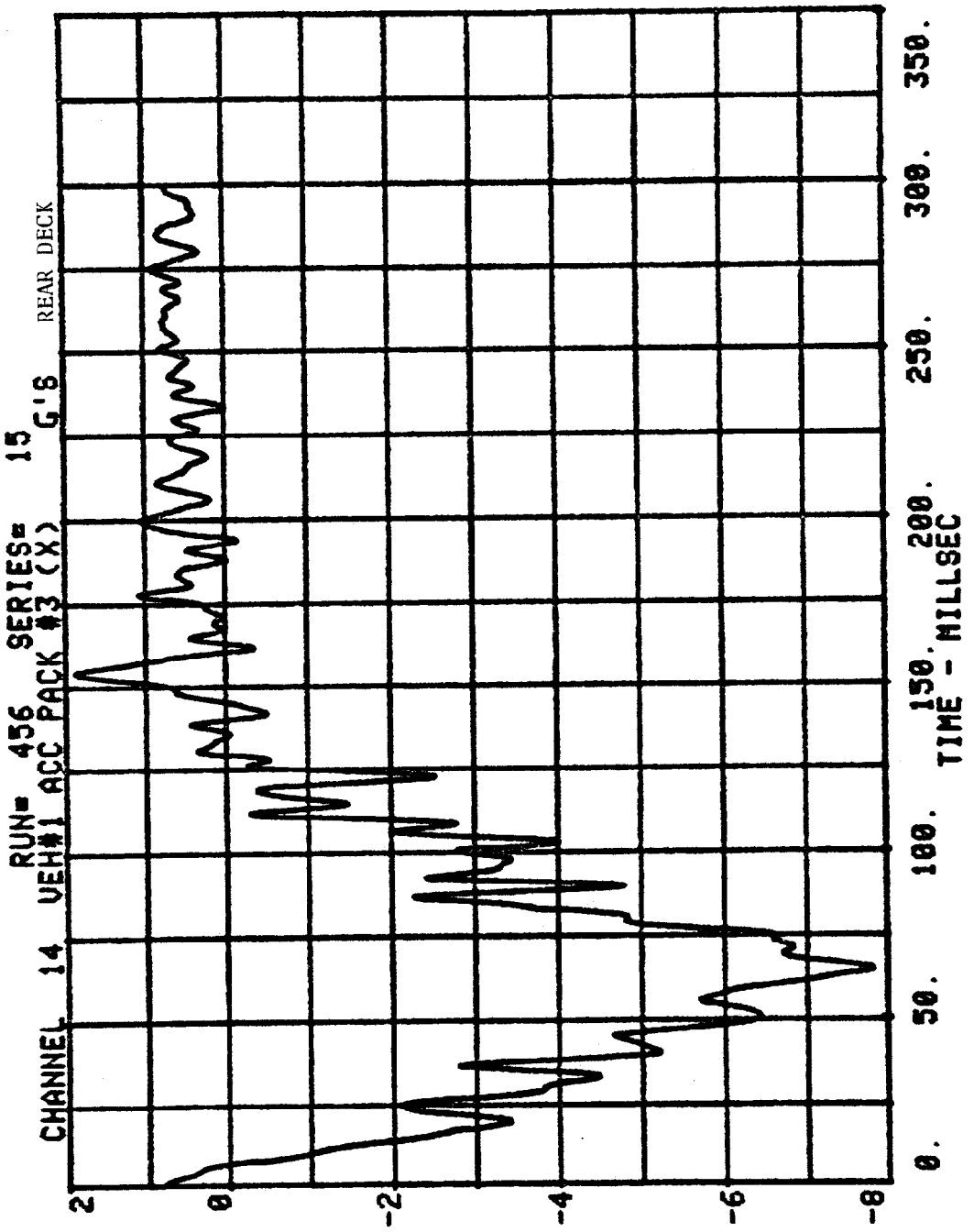

CHANNEL 13 VELOCITY RUN= 456 SERIES= 15 MPH
VEHICLE PACK #1 X
LEFT COMPARTMENT
32
24
16
8
0
-8
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

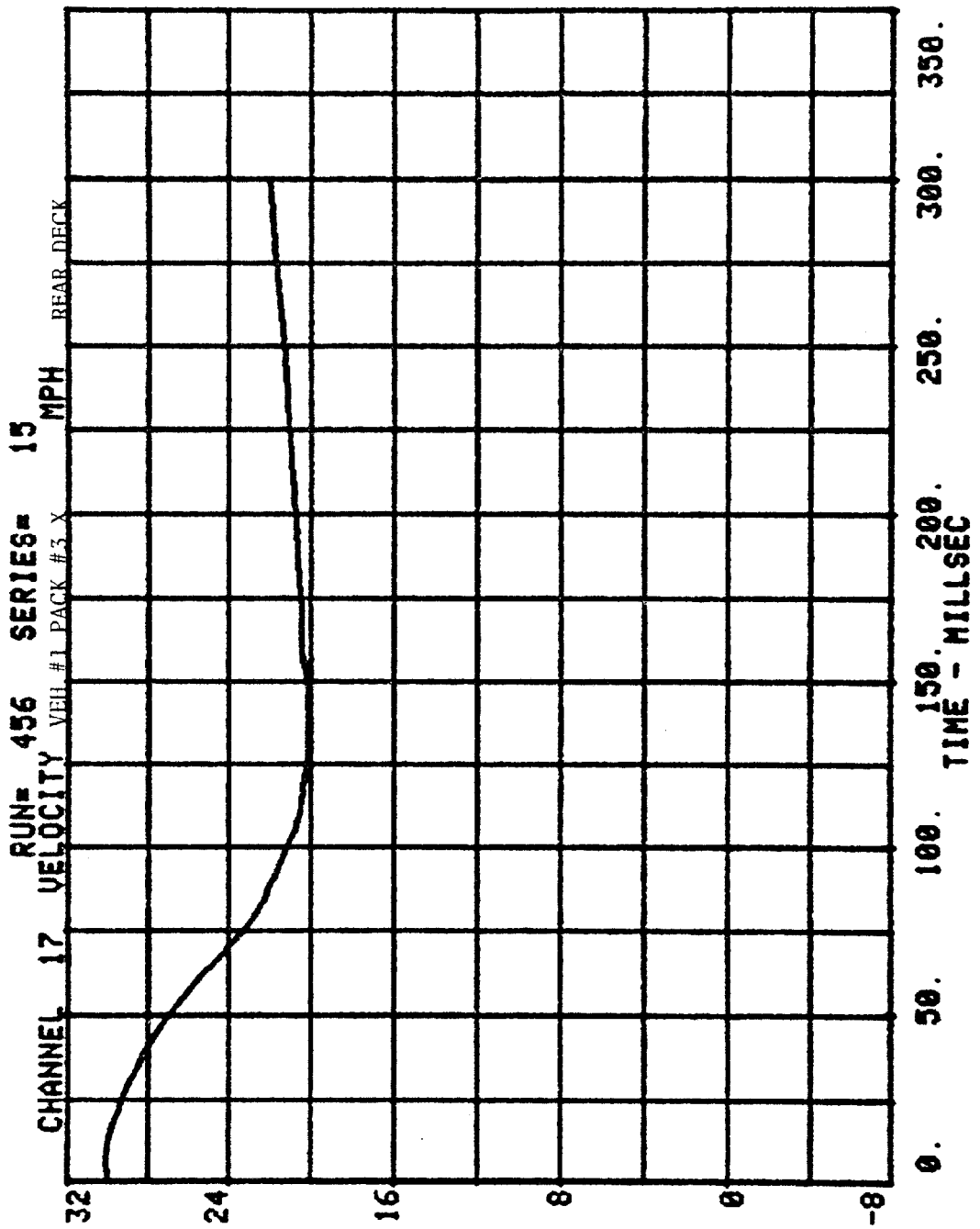

CHANNEL 14 DISPLACEMENT
RUN= 456 SERIES= 15
VEH #1 PACK #1 X INCHES
LEFT COMPARTMENT
160
120
80
40
0
-40
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

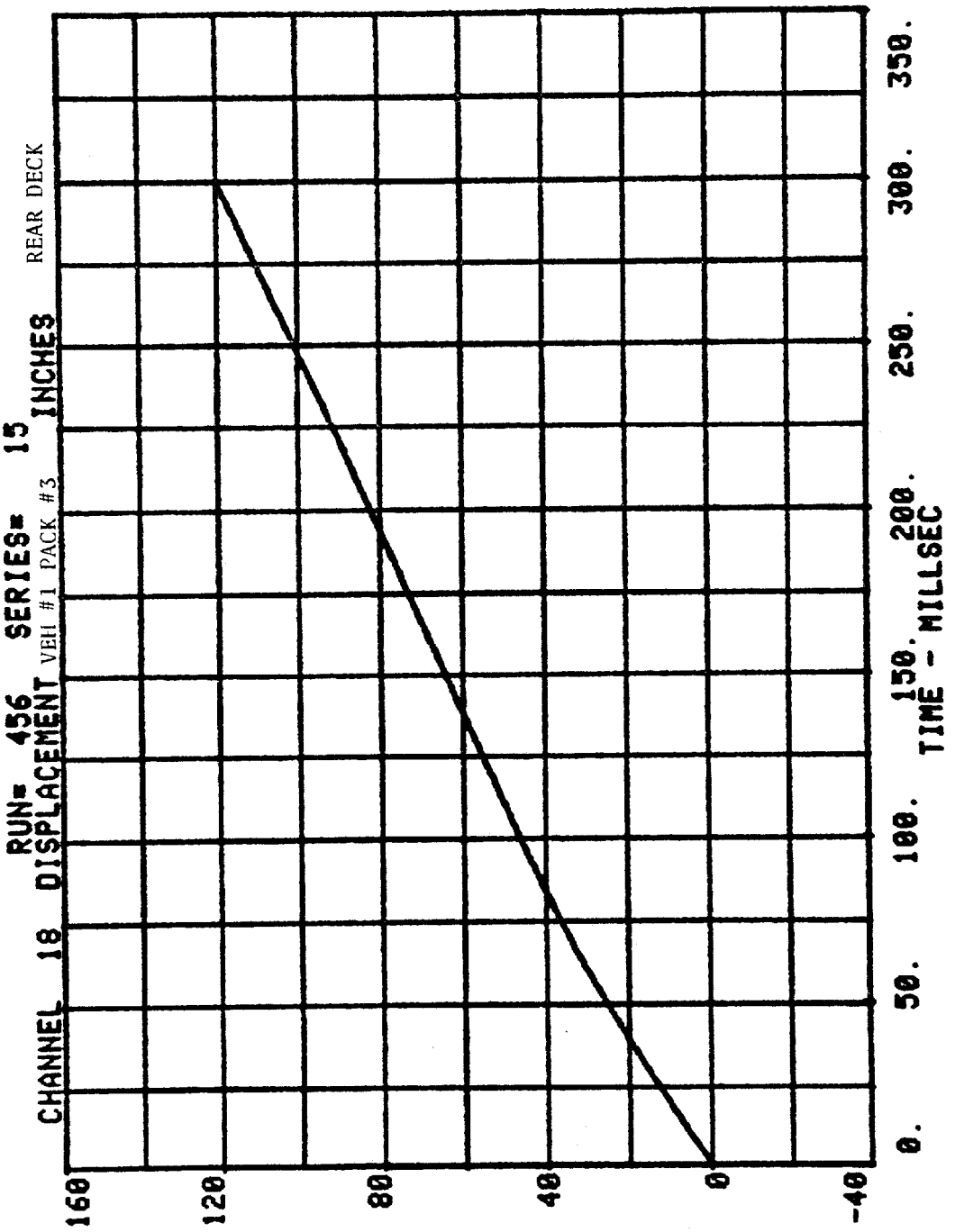

RIGHT COMPARTMENT
CHANNEL 13 VEH#1 ACC PACK #2 (X)
RUN= 456 SERIES= 15
G'S
2.5
0.0
-2.5
-5.0
-7.5
-10.0
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

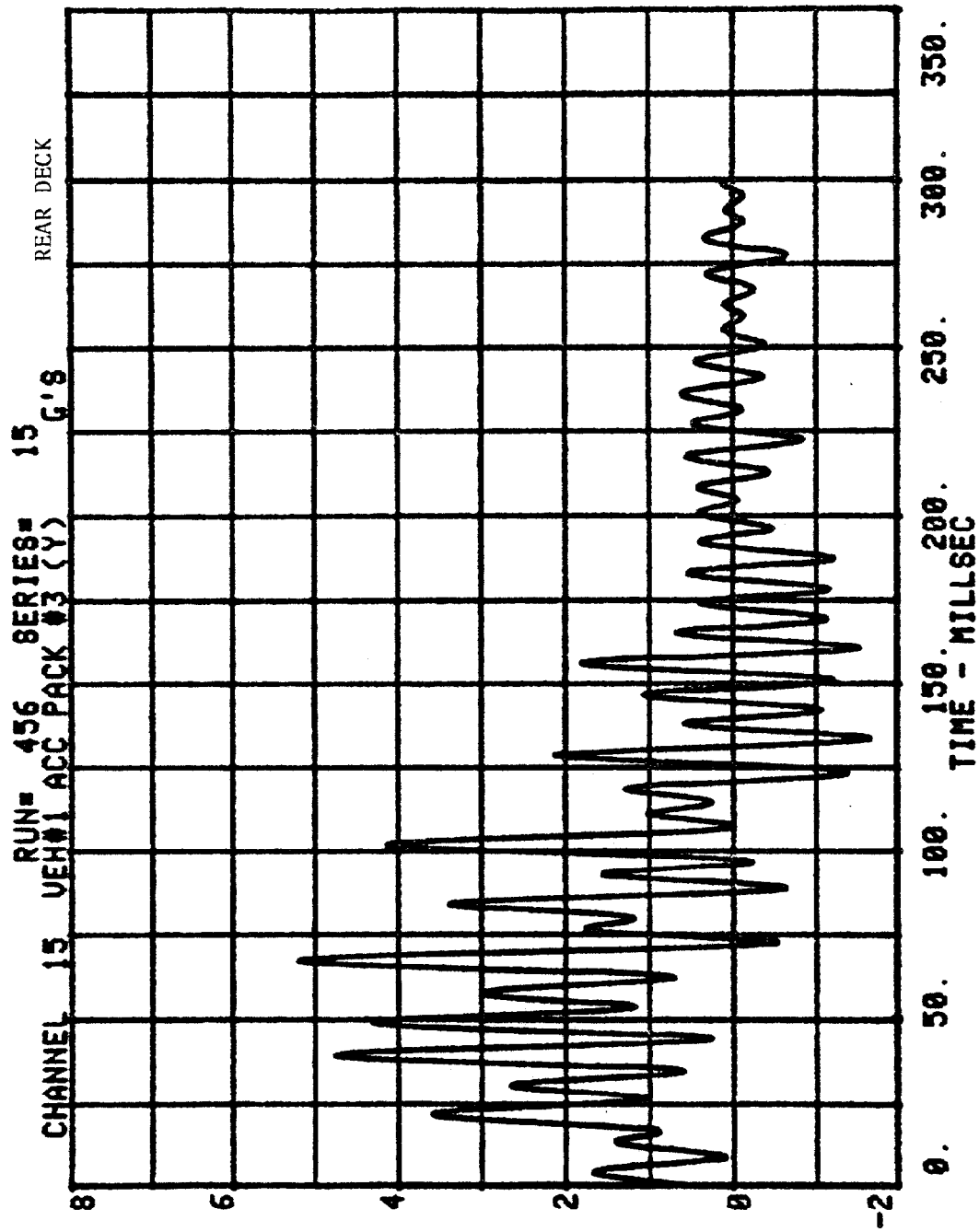

CHANNEL 15 VELOCITY RUN= 456 SERIES= 15 MPH
VEH #1 PACK #2 X RIGHT COMPARTMENT
32
24
16
8
0
-8
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

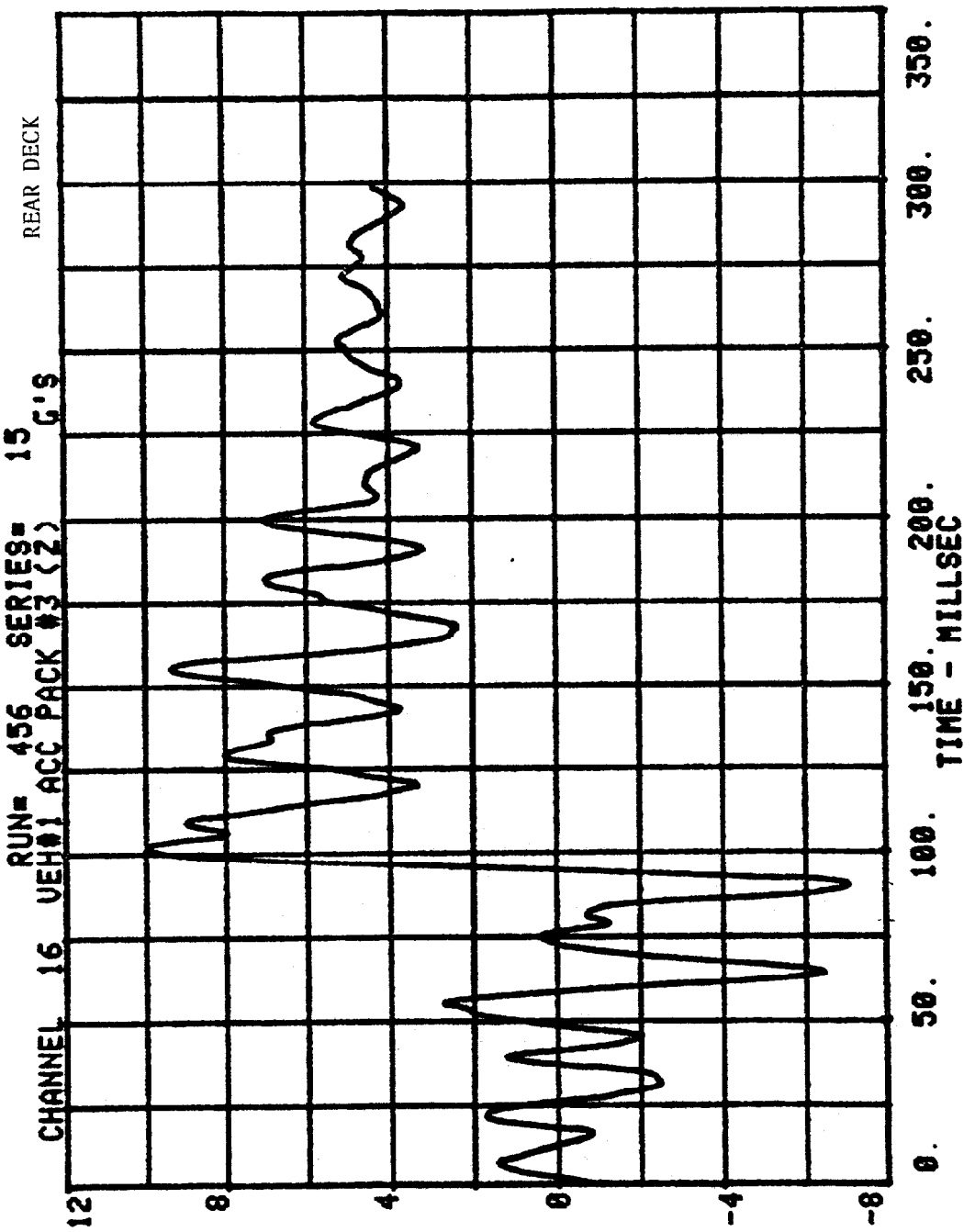

CHANNEL 16 RUN= 456 SERIES= 15
DISPLACEMENT VEH #1 PACK #1 X INCHES RIGHT COMPARTMENT
160
120
80
40
0
-40
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

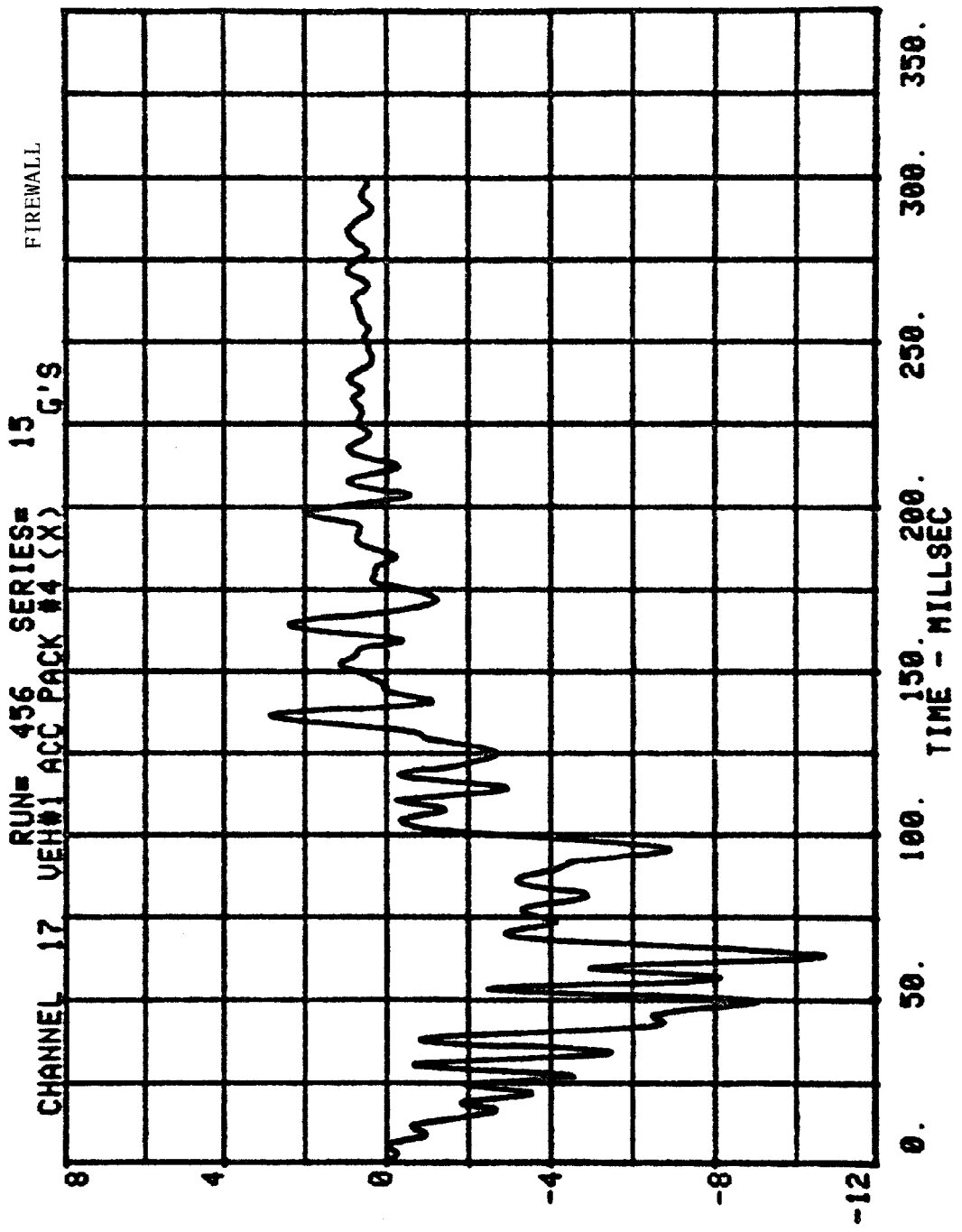

CHANNEL 14 VEH#1 ACC PACK #3 (X)
RUN= 456 SERIES= 15 G'S
REAR DECK
2
0
-2
-4
-6
-8
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

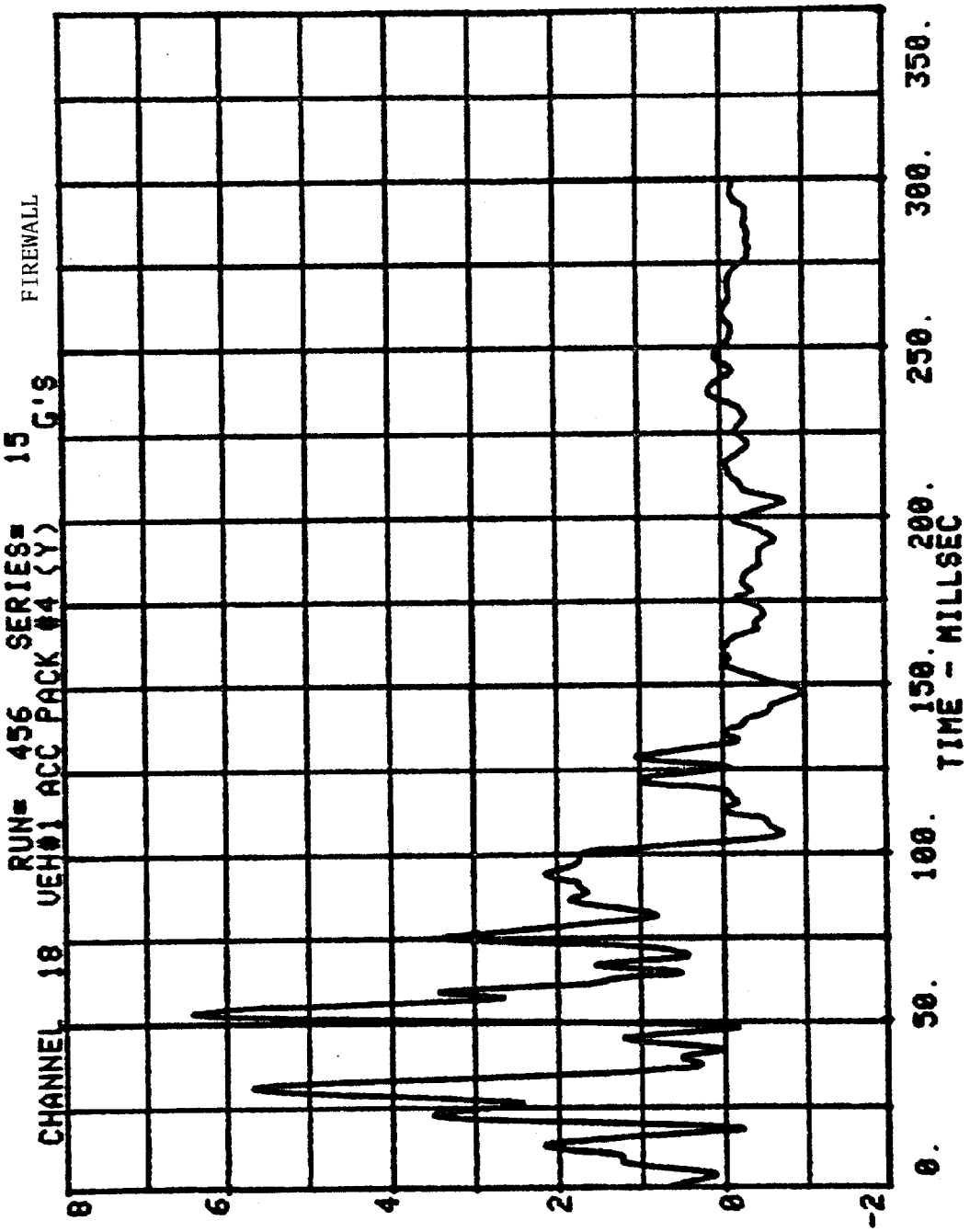

CHANNEL 17 VELOCITY RUN= 456 SERIES= 15 MPH
VEH #1 PACK #3 X REAR DECK
32
24
16
8
0
-8
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

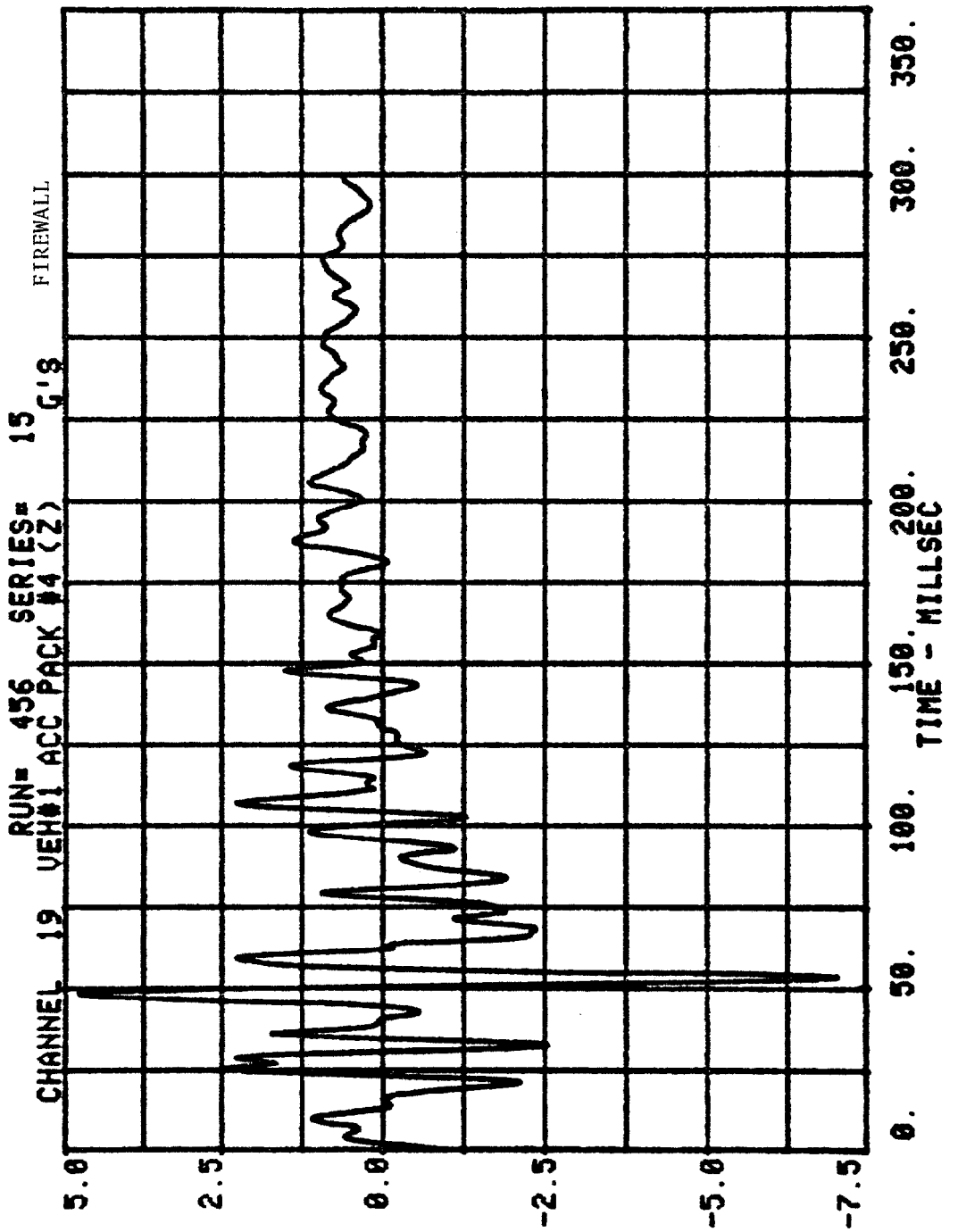

CHANNEL 18 DISPLACEMENT
RUN= 456 SERIES= 15
VEH #1 PACK #3
REAR DECK
INCHES
160
120
80
40
0
-40
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

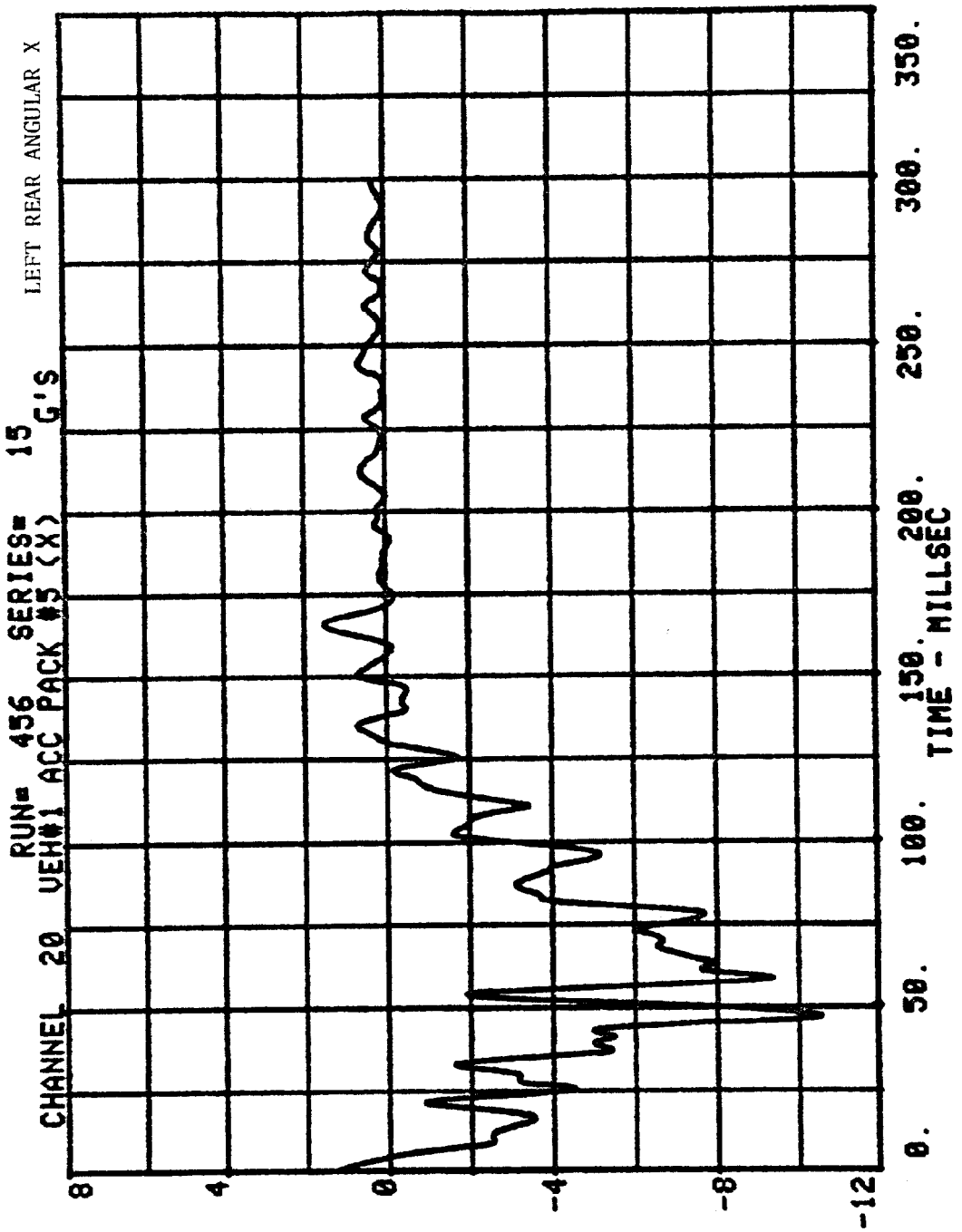

CHANNEL 15 VEH#1 ACC PACK #3 (Y)
RUN= 456 SERIES= 15
G'S
REAR DECK
8.
6.
4.
2.
0.
-2
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

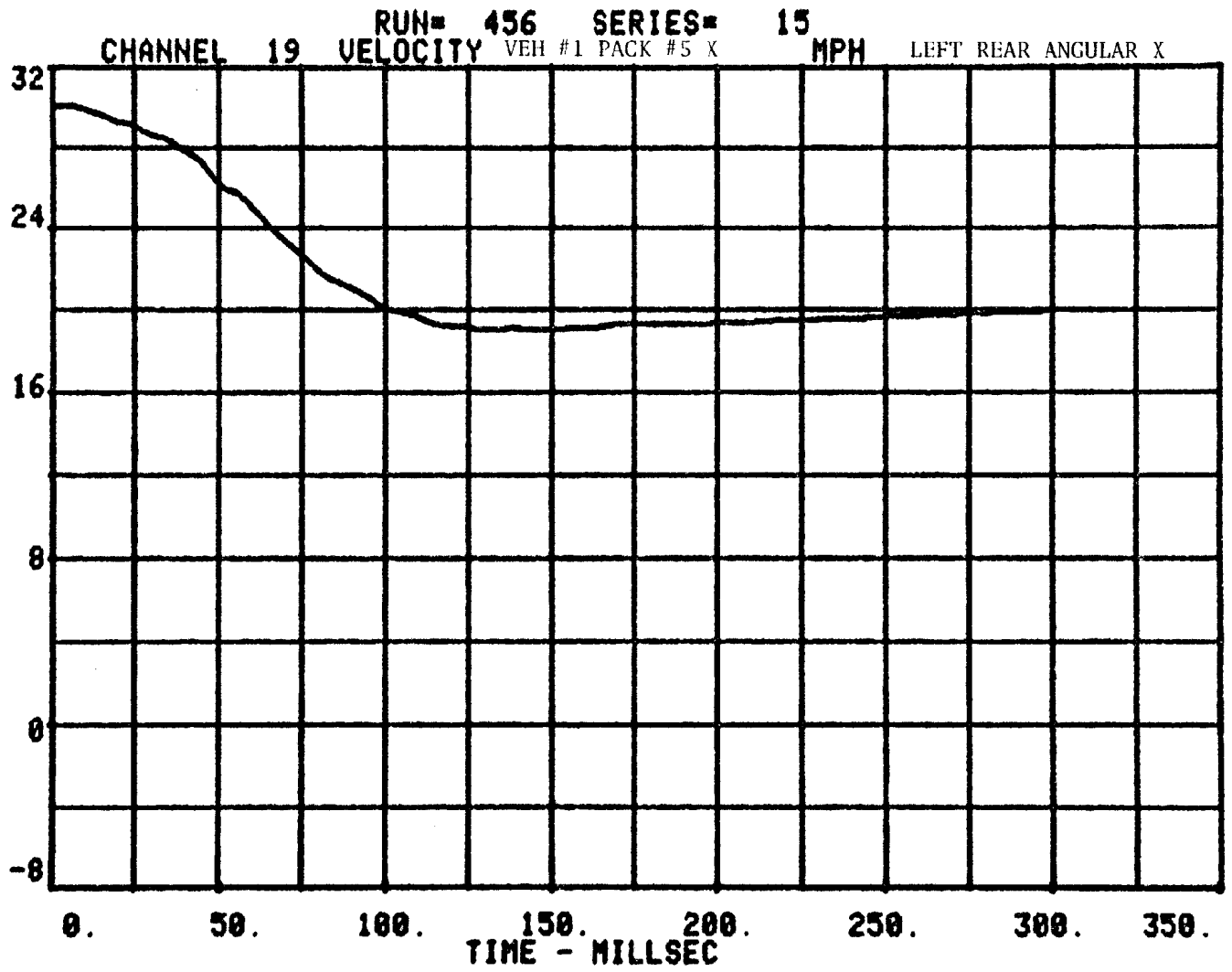

REAR DECK
CHANNEL 16 VEH#1 ACC PACK #3 (2)
RUN= 456 SERIES= 15 G'S
12
8
4
0
-4
-8
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

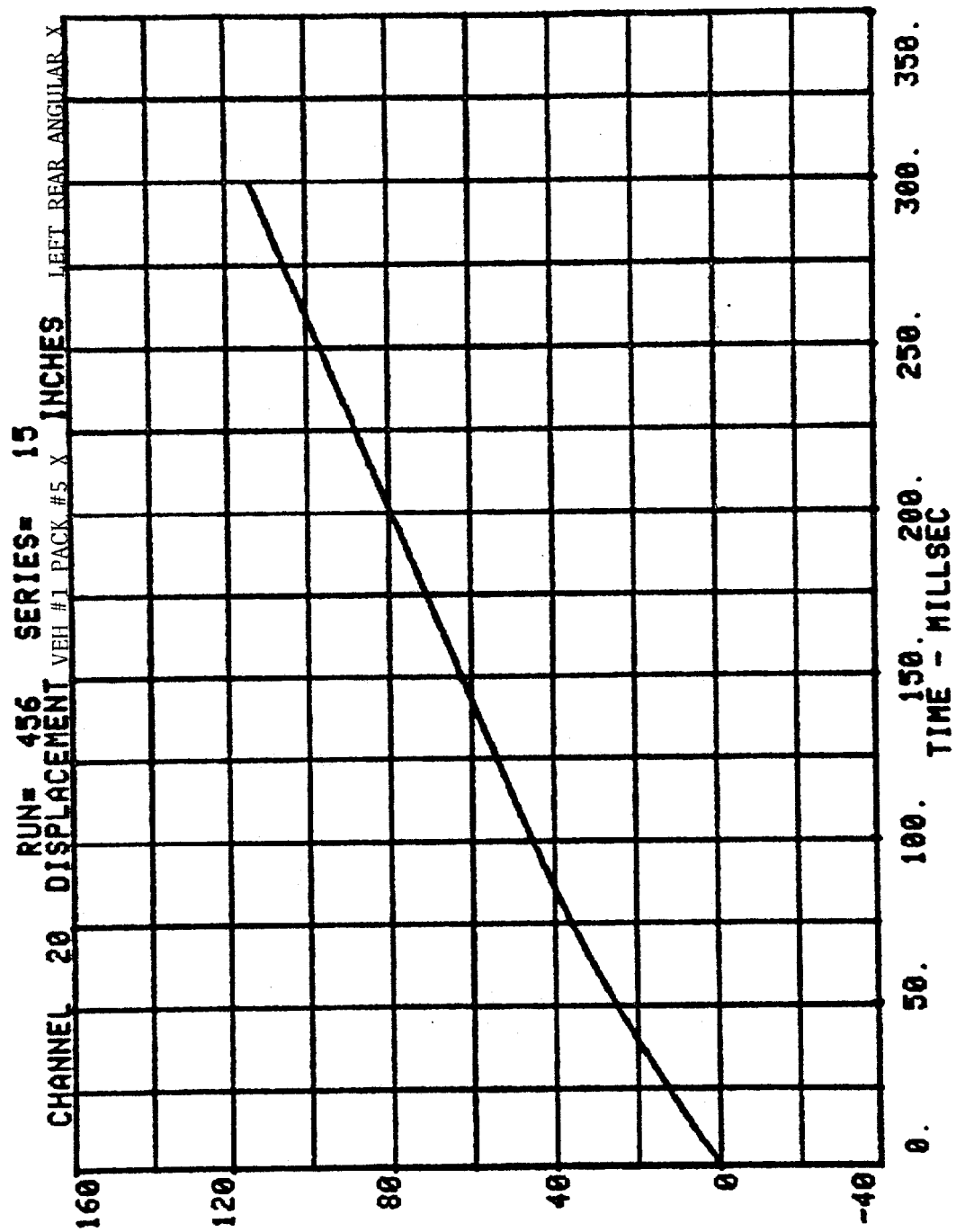

CHANNEL 17 VEH#1 ACC PACK #4 (X)
RUN= 456 SERIES= 15
G'S
FIREWALL
8
4
0
-4
-8
-12
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

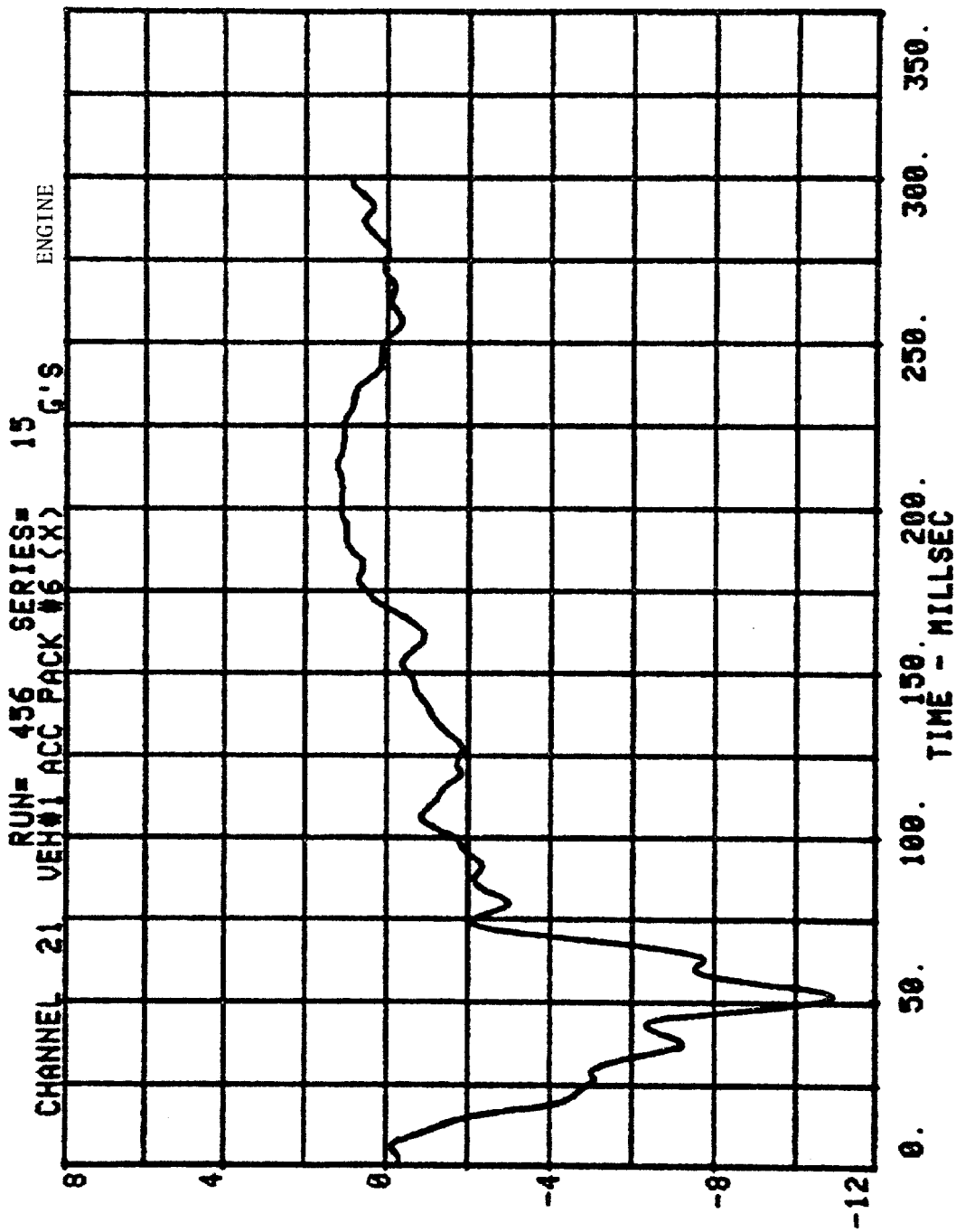

CHANNEL 18 VEH#1 ACC PACK #4 (Y)
RUN= 456 SERIES= 15
FIREWALL
G'S
8
6
4
2
0
-2
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 19 VEH#1 ACC PACK #4 (Z)
RUN= 456 SERIES= 15
G'S
FIREWALL
5.0
2.5
0.0
-2.5
-5.0
-7.5
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

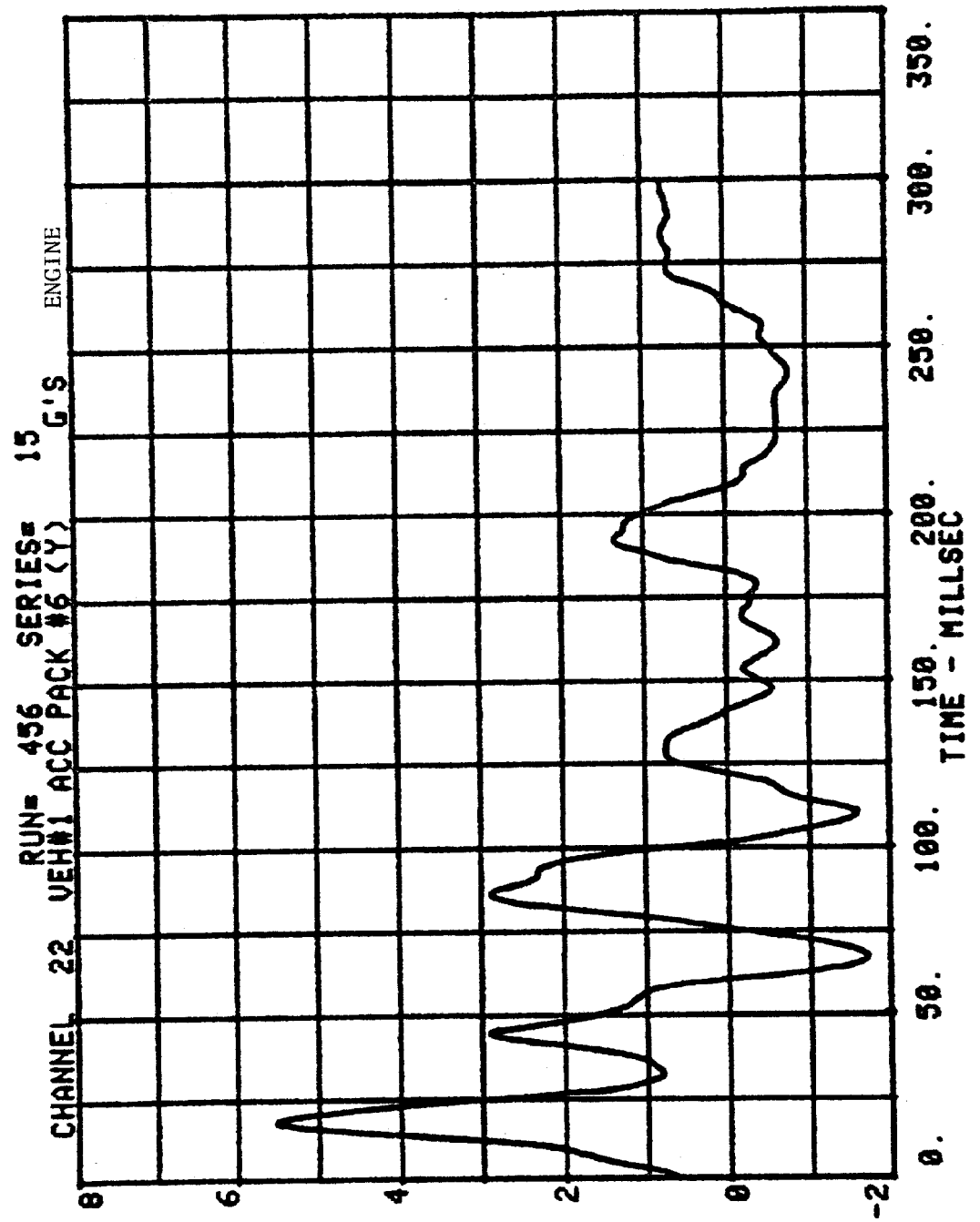

CHANNEL 20 VEH#1 ACC PACK #5 (X)
RUN= 456 SERIES= 15
LEFT REAR ANGULAR X
G'S
8
4
0
-4
-8
-12
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

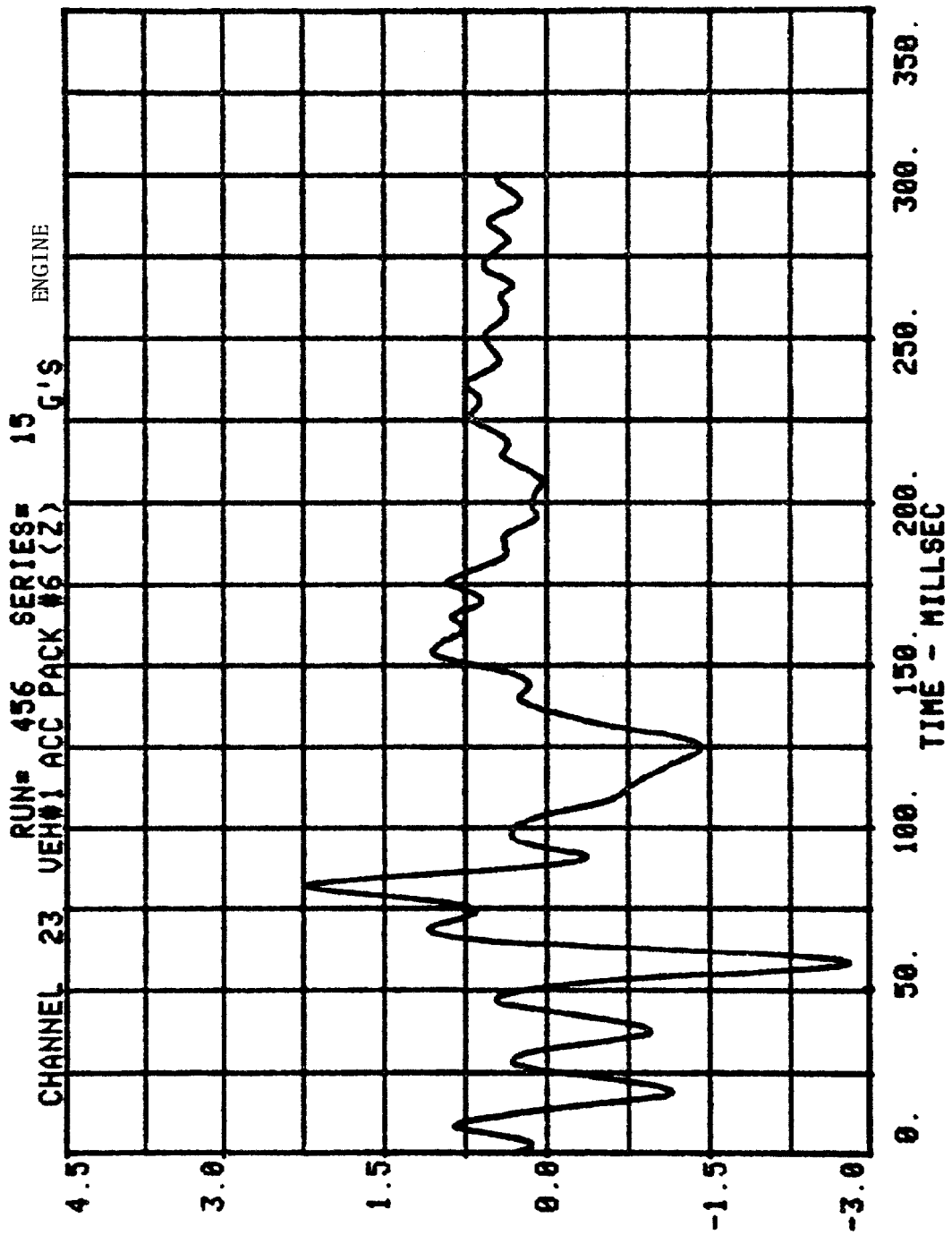

RUN= 456 SERIES= 15
CHANNEL 19 VELOCITY VEH #1 PACK #5 X MPH LEFT REAR ANGULAR X
32
24
16
8
0
-8
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

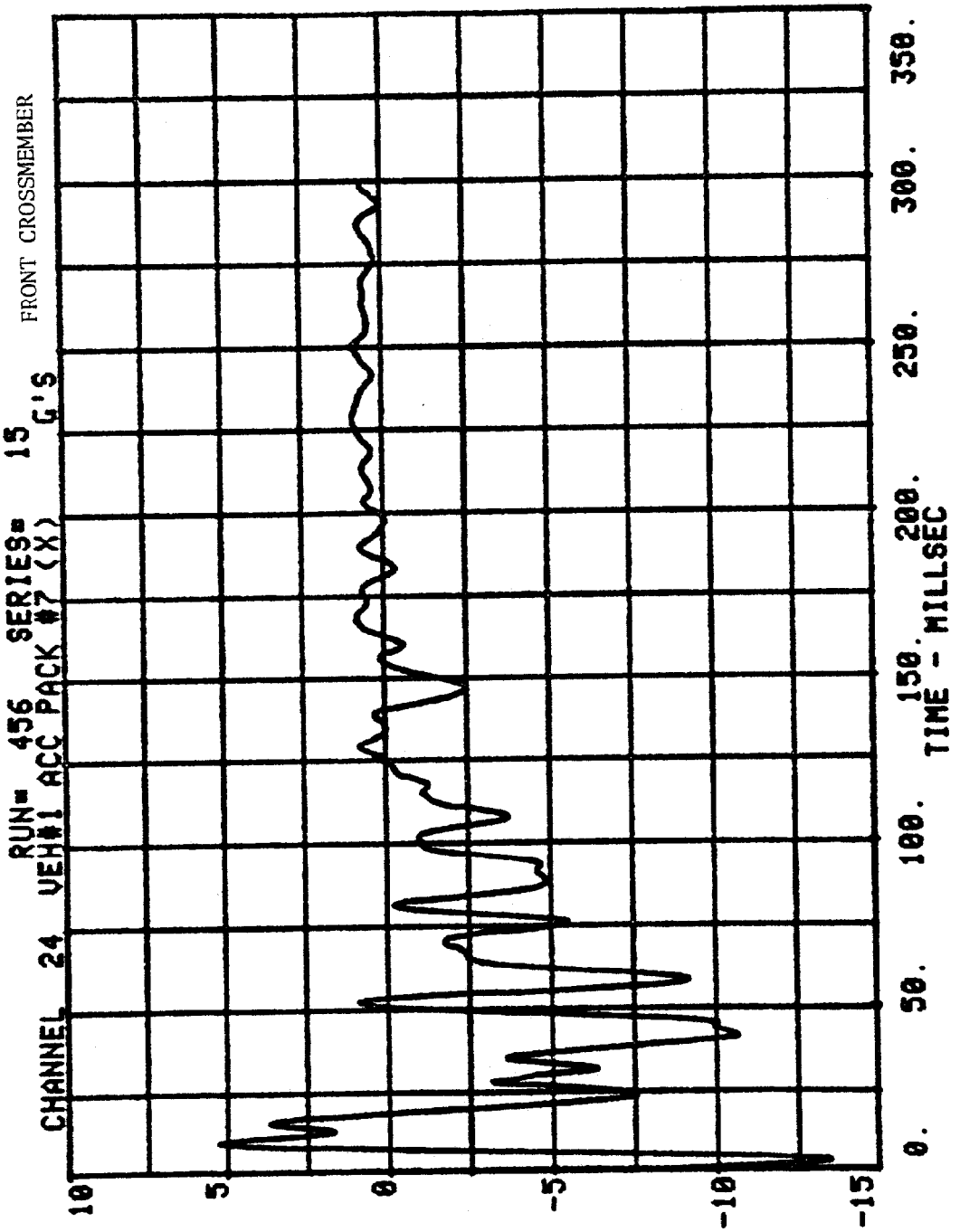

CHANNEL 20 RUN= 456 SERIES= 15
DISPLACEMENT VEH #1 PACK #5 X INCHES LEFT REAR ANGULAR X
160
120
80
40
0
-40
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

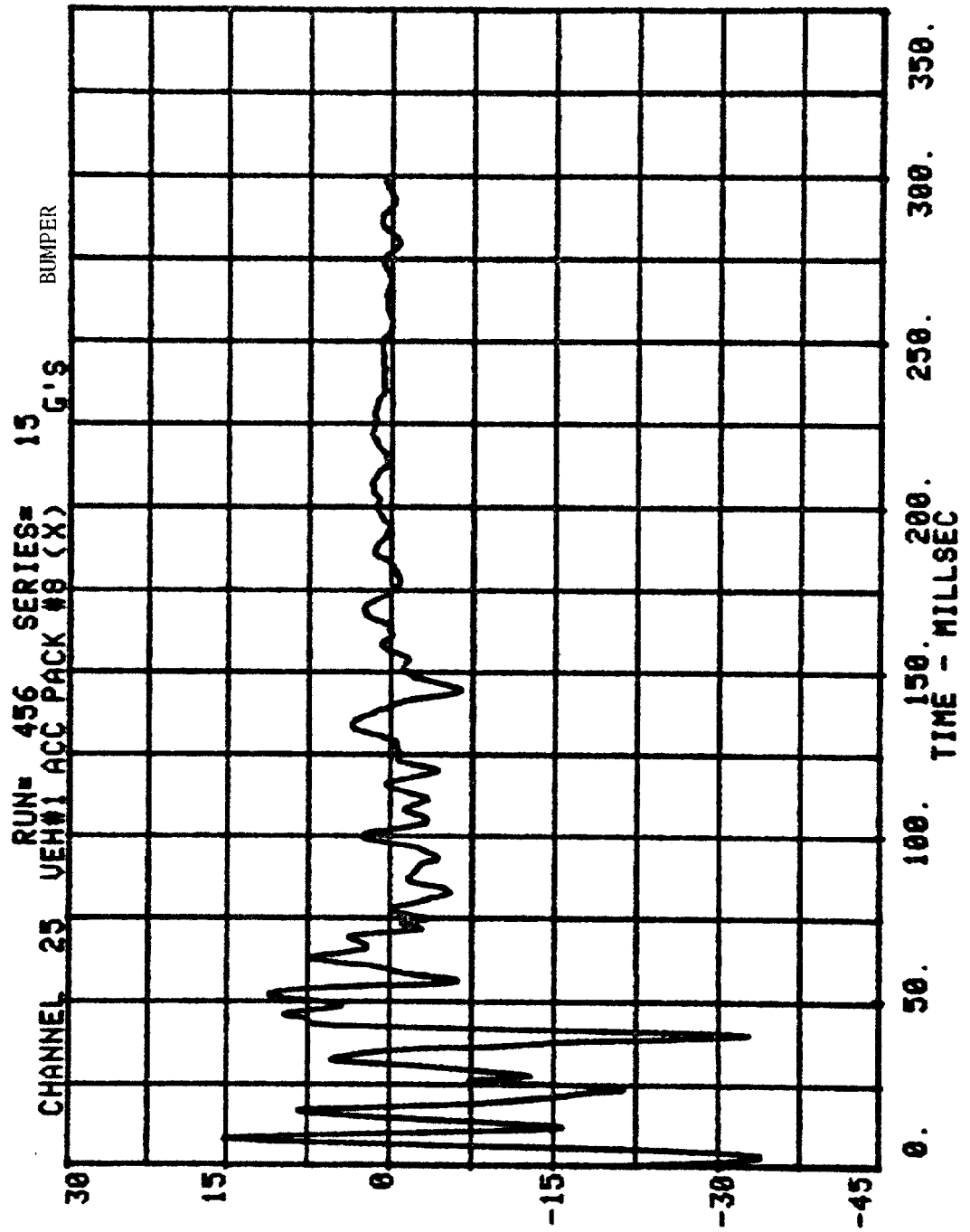

CHANNEL 21 VEH#1 ACC PACK #6 (X) ENGINE
RUN= 456 SERIES= 15 G'S
8
4
0
-4
-8
-12
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

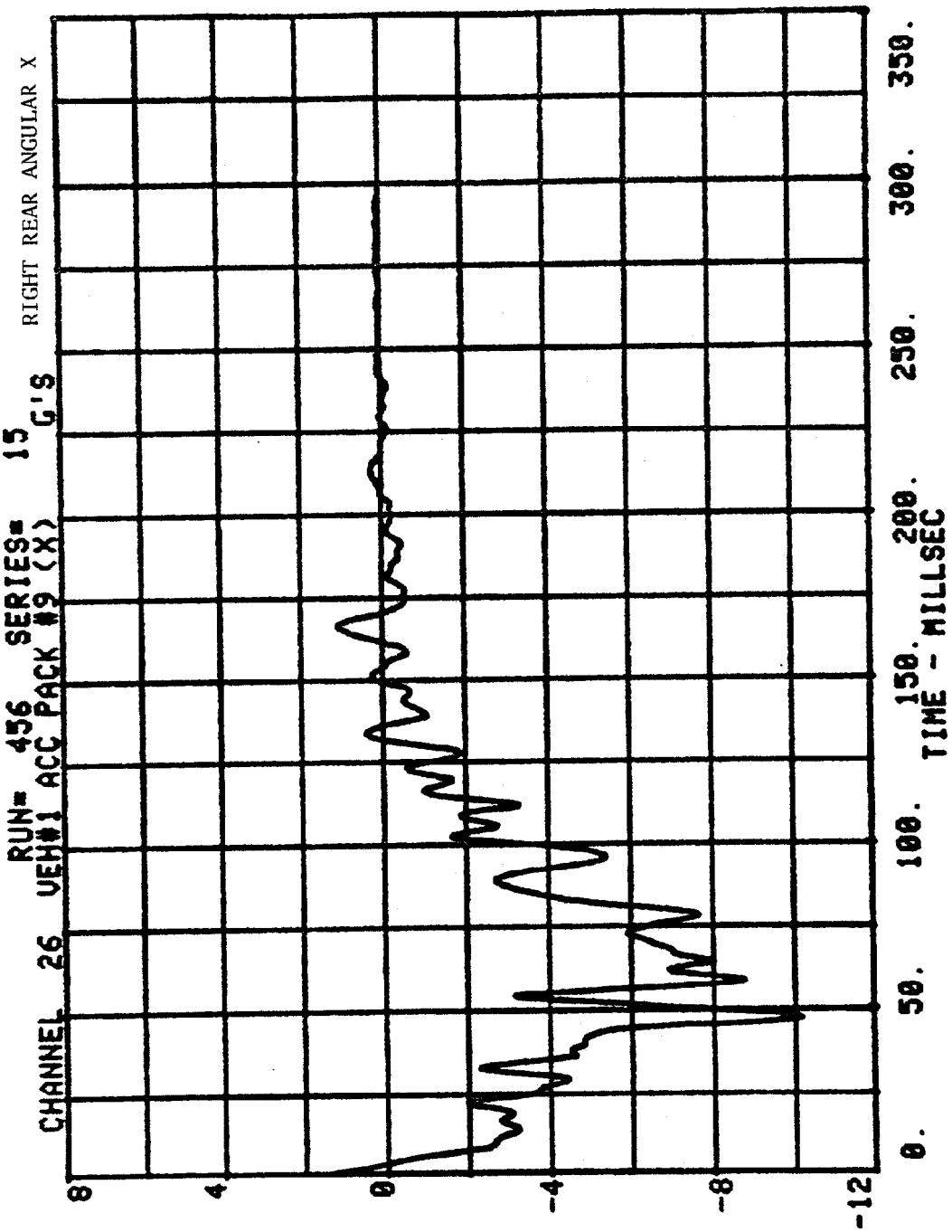
(22) OK

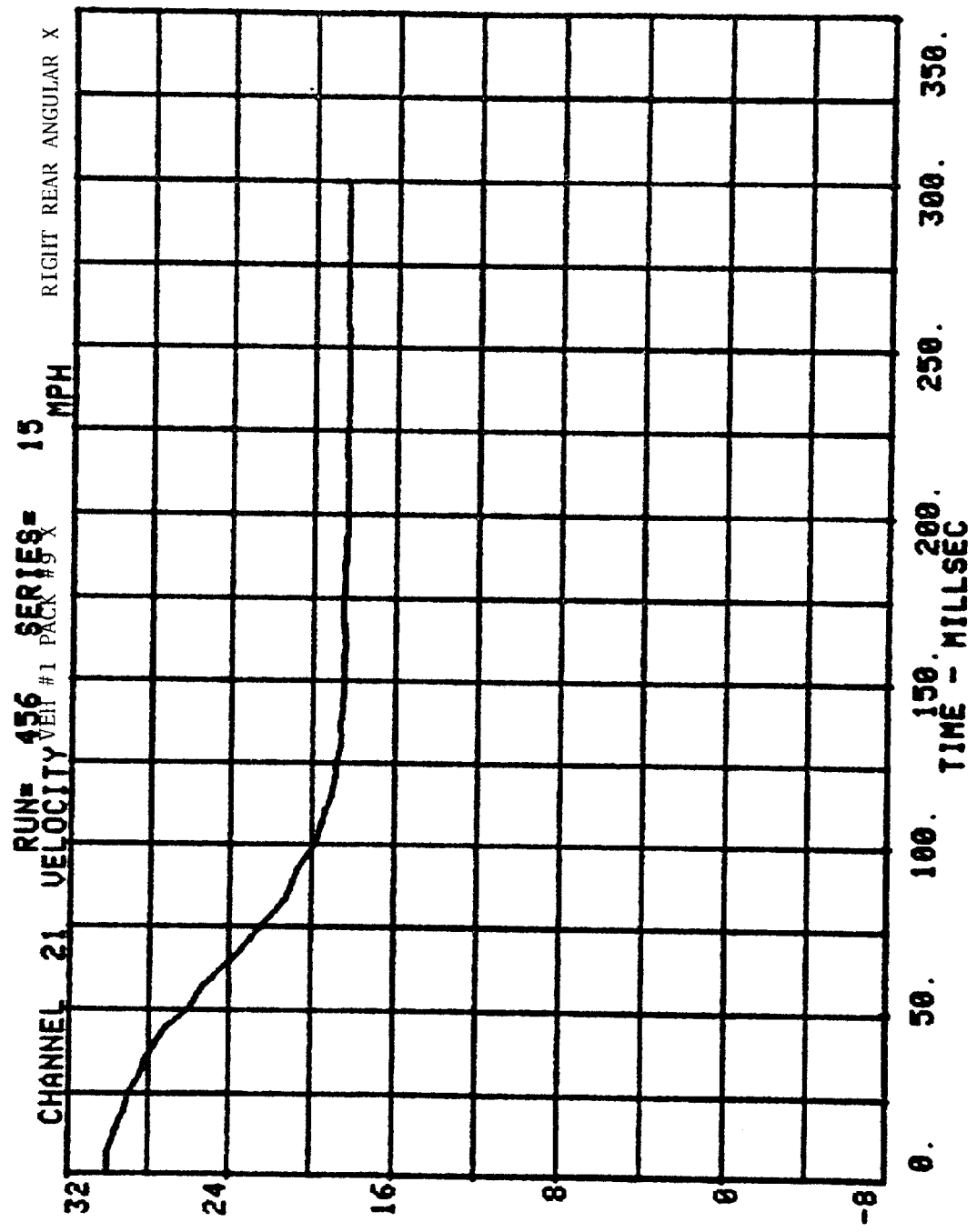

CHANNEL 22 VEH#1 ACC PACK #6 (Y)
RUN= 456 SERIES= 15
G'S
ENGINE
8
6
4
2
0
-2
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

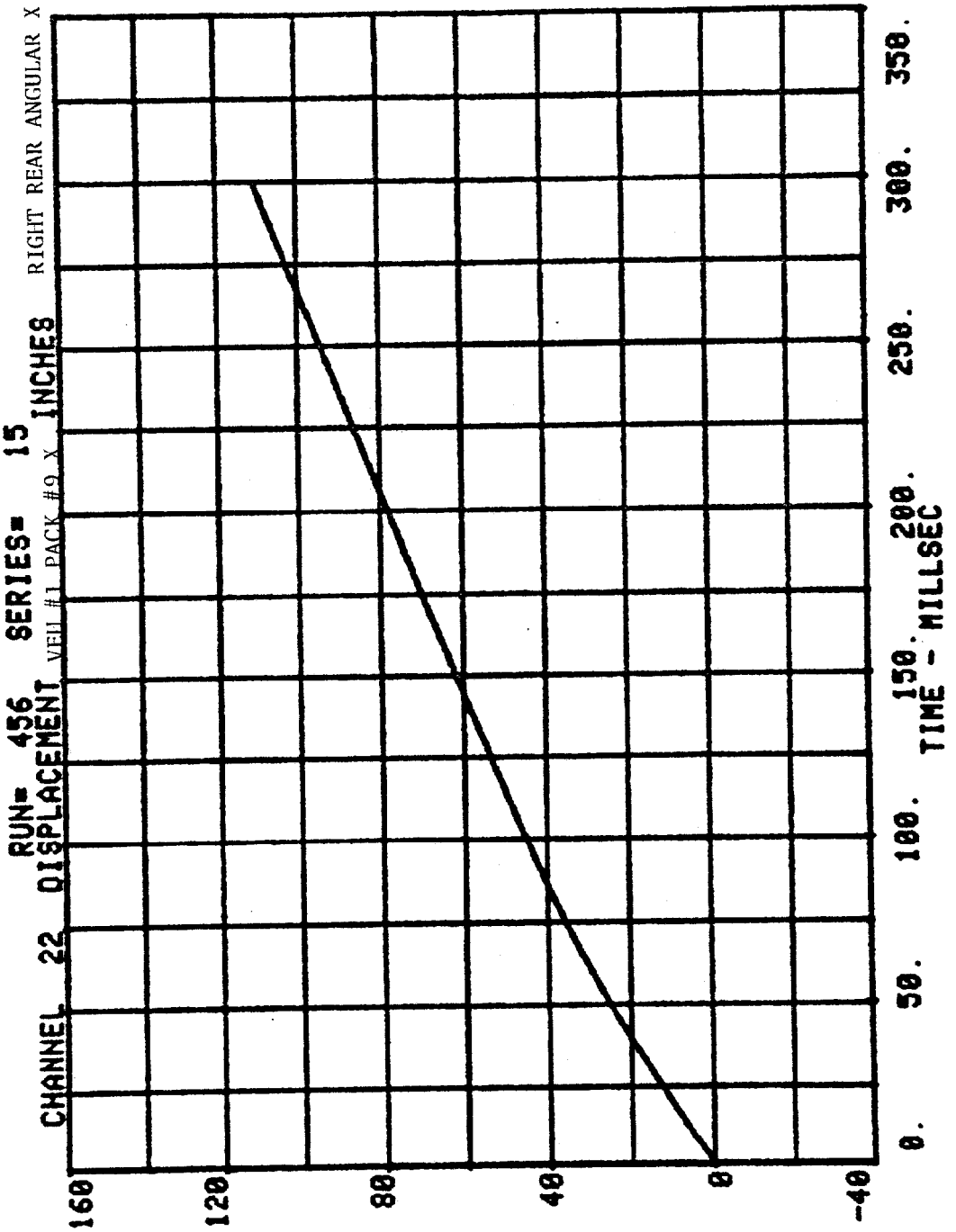

CHANNEL 23 VEH#1 ACC PACK #6 (Z)
RUN= 456 SERIES= 15
G'S
ENGINE
4.5
3.0
1.5
0.0
-1.5
-3.0
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

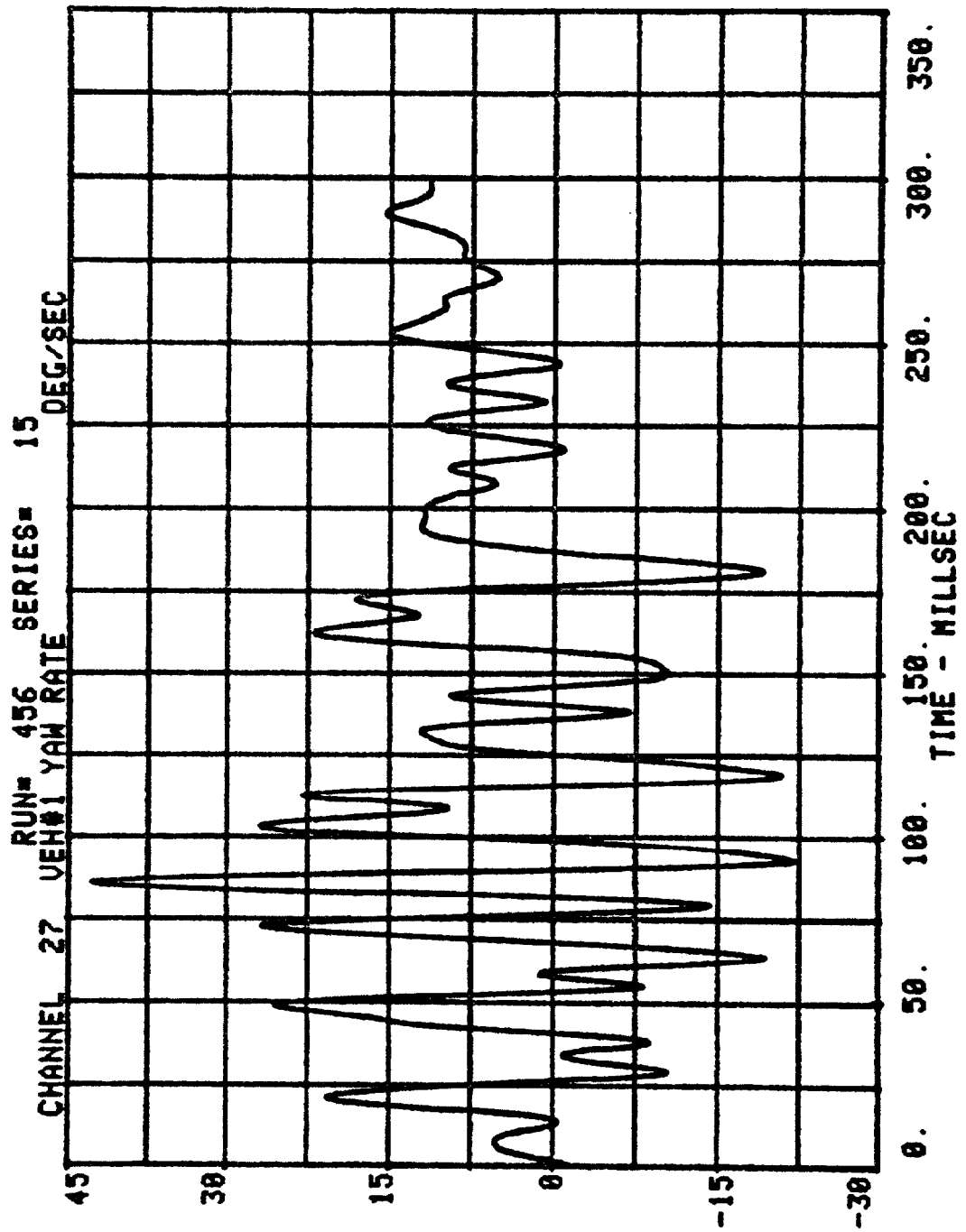

CHANNEL 24 VEH#1 ACC PACK #2 (X) RUN= 456 SERIES= 15 G'S
FRONT CROSSMEMBER
10
5
0
-5
-10
-15
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 25 VEH#1 ACC PACK #8 (X)
RUN= 456 SERIES= 15
G'S
BUMPER
30
15
0
-15
-30
-45
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


RIGHT REAR ANGULAR X
CHANNEL 26 VEH#1 ACC PACK #9 (X) RUN= 456 SERIES= 15
G'S
8
4
0
-4
-8
-12
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 21 RUN= 456 SERIES= 15
VELOCITY VEH #1 PACK #9 X MPH
RIGHT REAR ANGULAR X
32
24
16
8
0
-8
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 22 RUN= 456 SERIES= 15
DISPLACEMENT VEH #1 PACK #9 X INCHES
RIGHT REAR ANGULAR X
160
120
80
40
0
-40
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 27 VEH#1 YAW RATE
RUN= 456 SERIES= 15 DEG/SEC
45
30
15
0
-15
-30
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

TEST NO. 14

VEHICLE NO. 1 - DUMMY DATA

	Channel Filter Class
Head Accelerations	1000 Hz
Chest Accelerations	180 Hz
Femur Forces	600 Hz
Belt Loads	60 Hz

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

BUDD #15 SIDE IMPACT TEST

RUN= 456

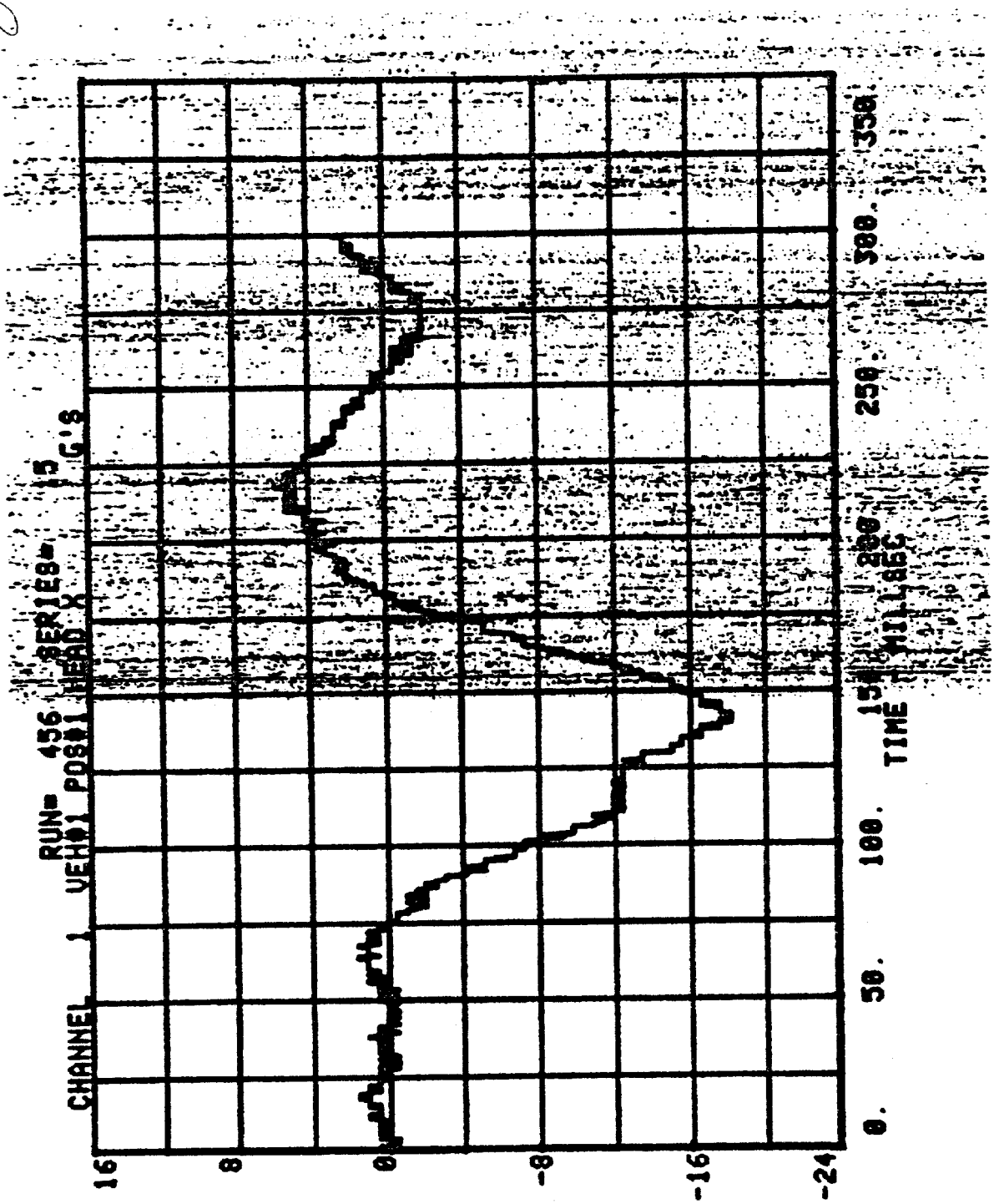
VEH#1 POS#1 HEAD RES.

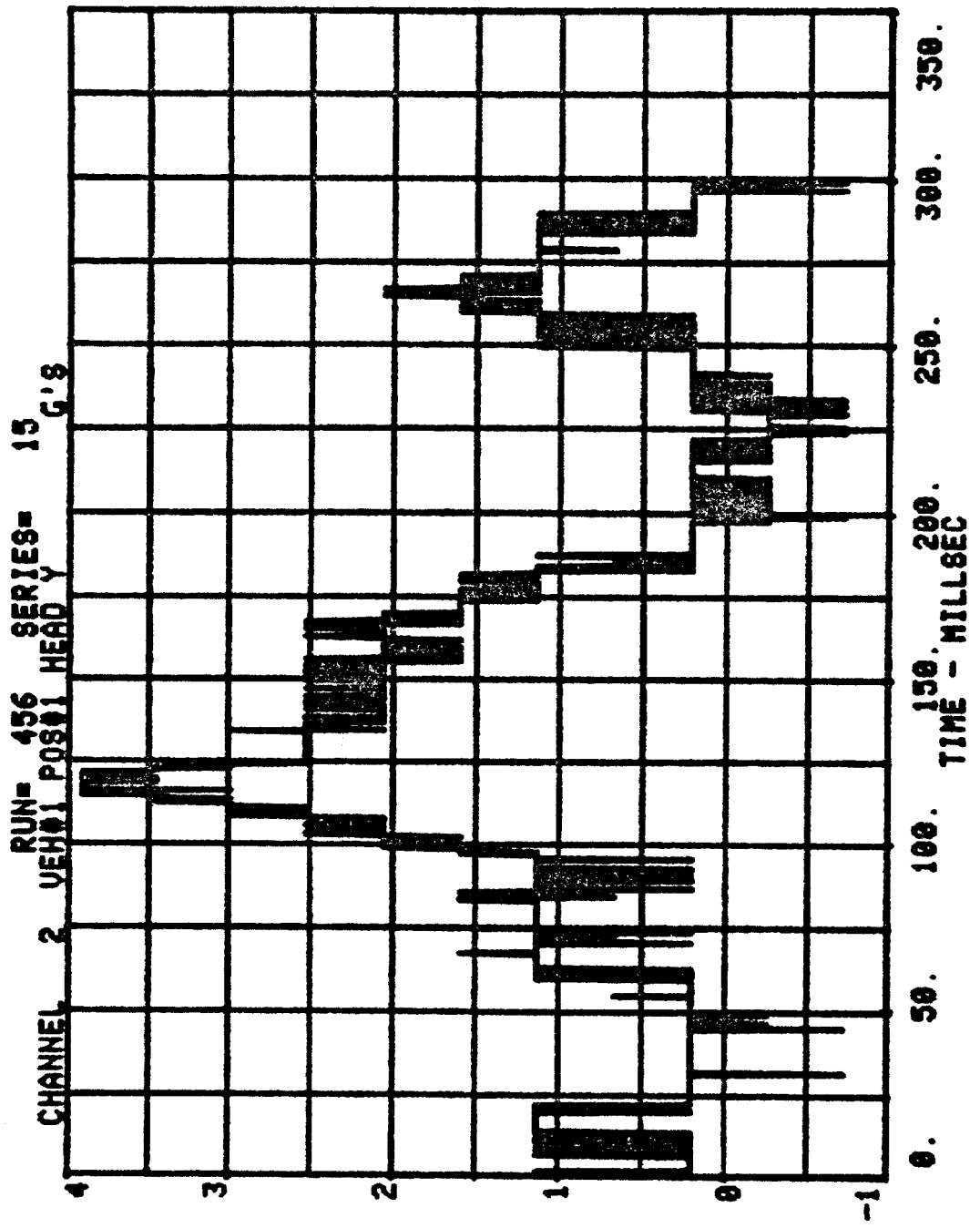
HIC= 60.7 FROM T1= .10230 TO T2= .16410

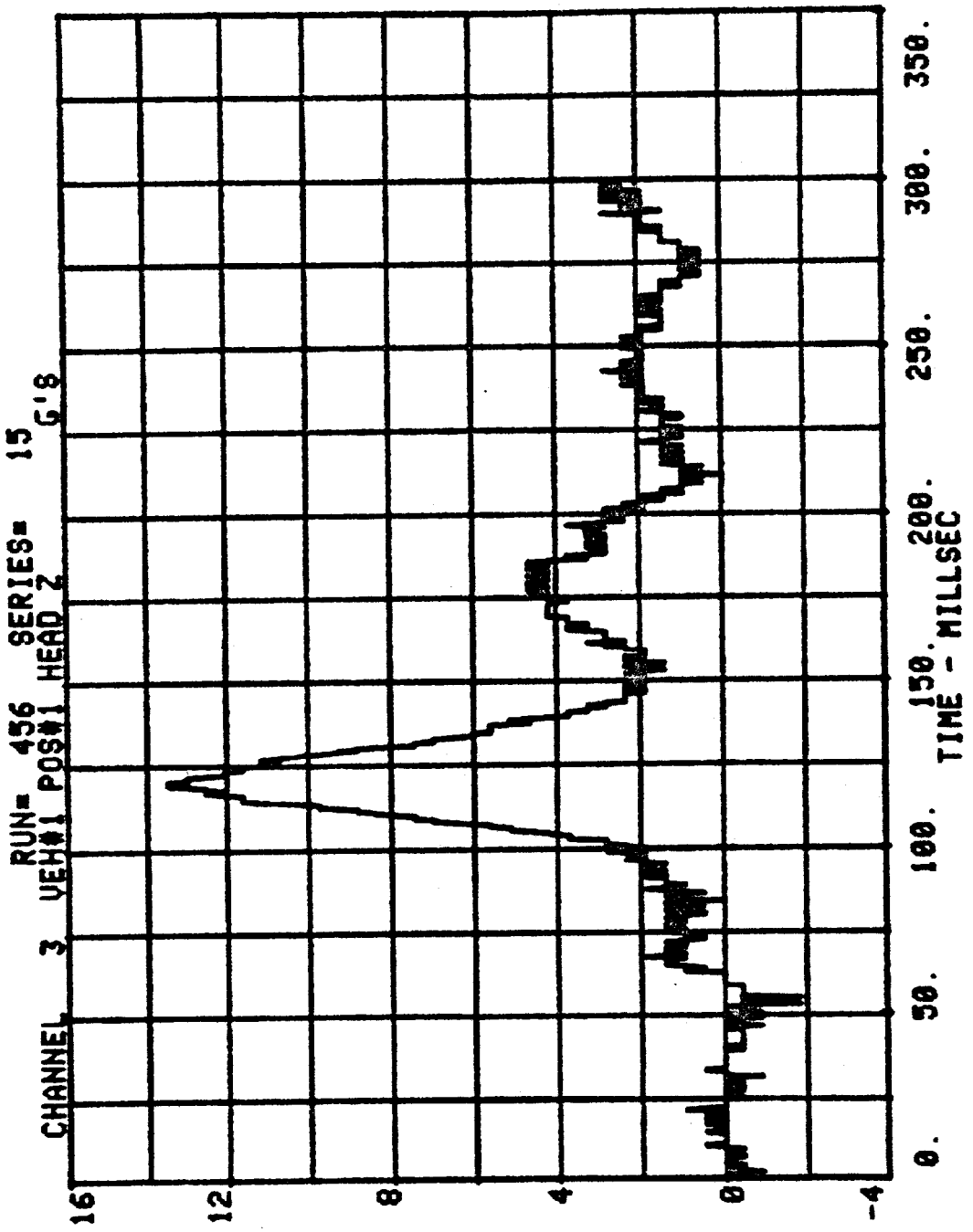
AVERAGE ACCELERATION BETWEEN T1 AND T2= 15.7G'S

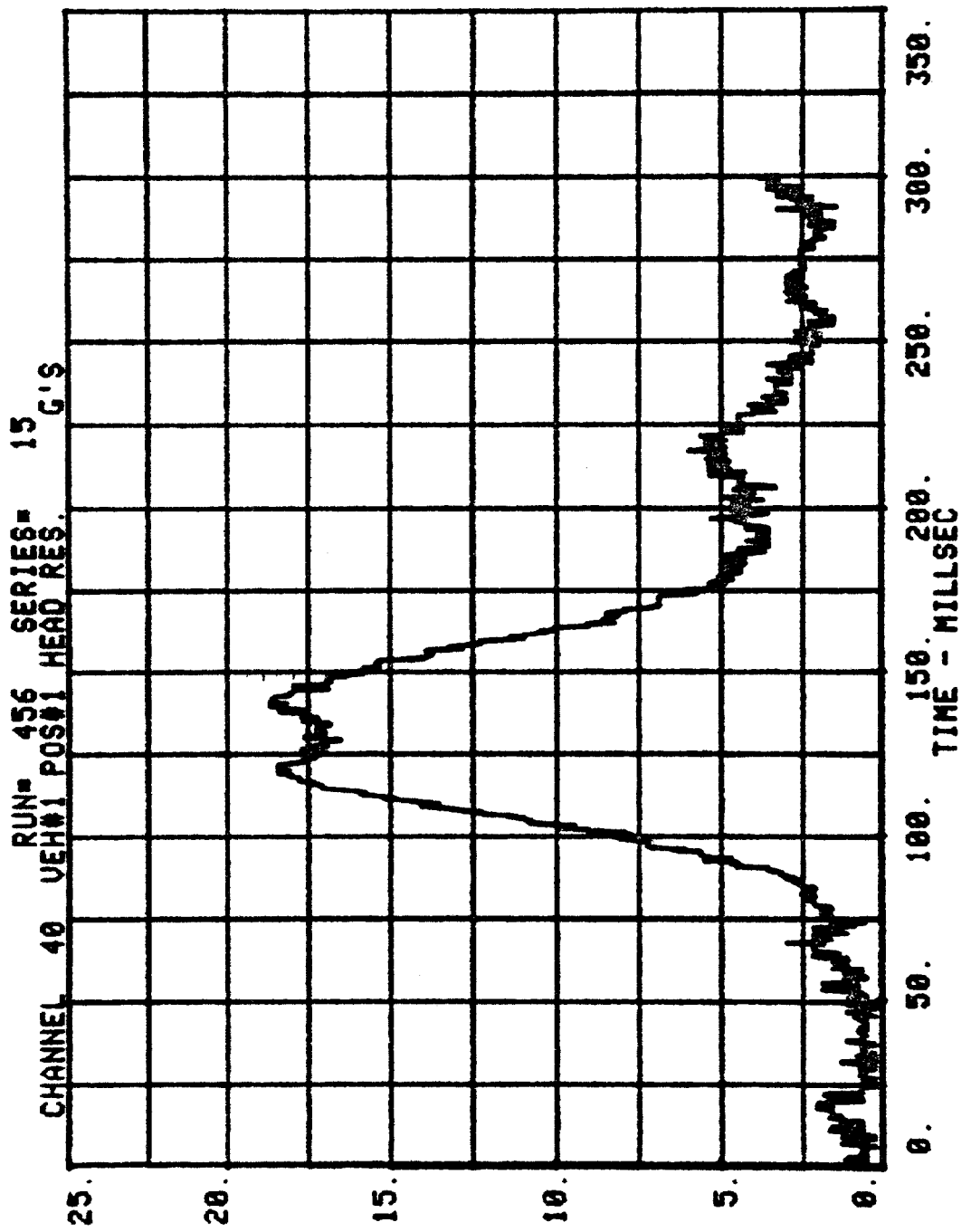
EVENT TIME= 300.0 MSEC

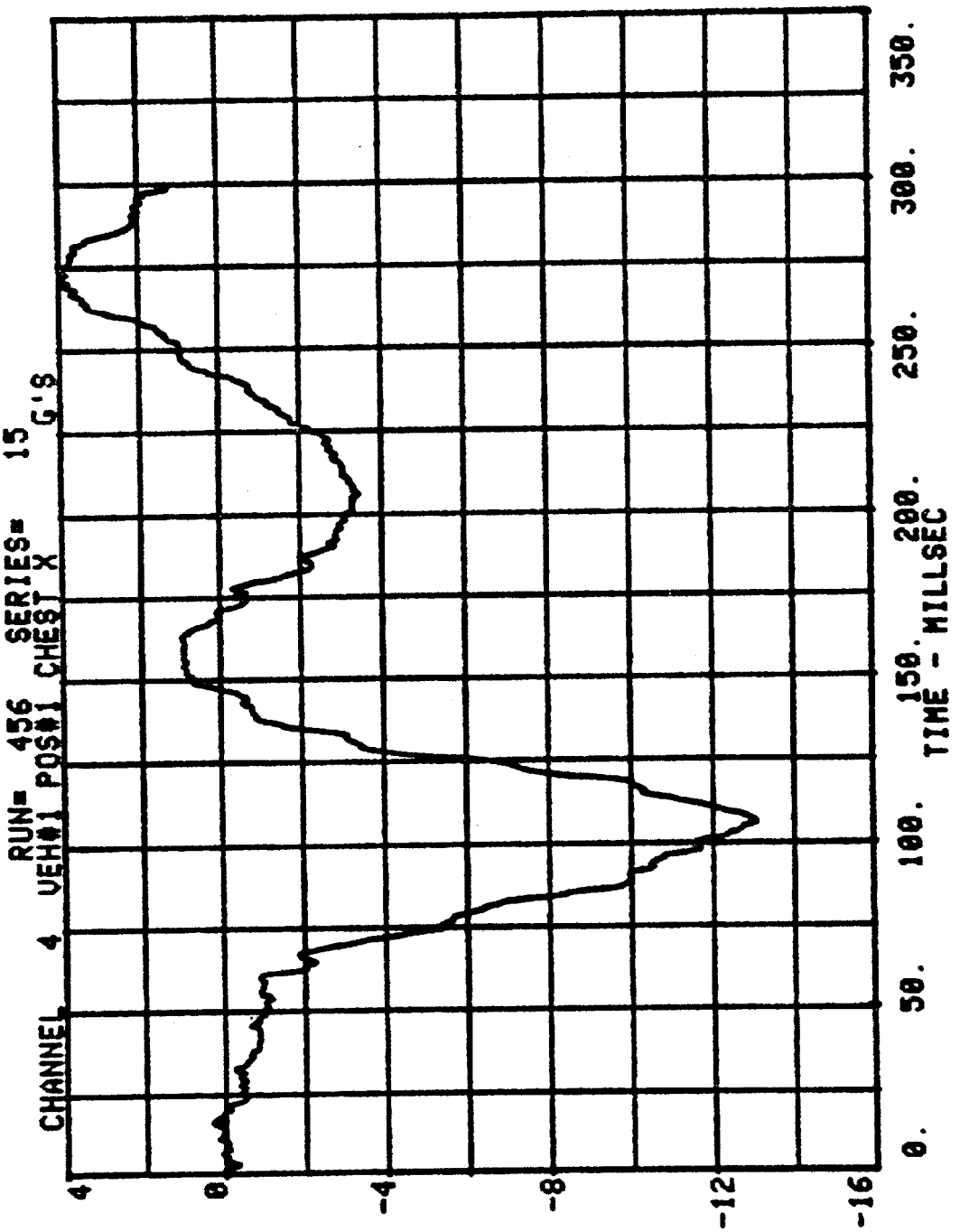
SEVERITY INDEX= 70.2

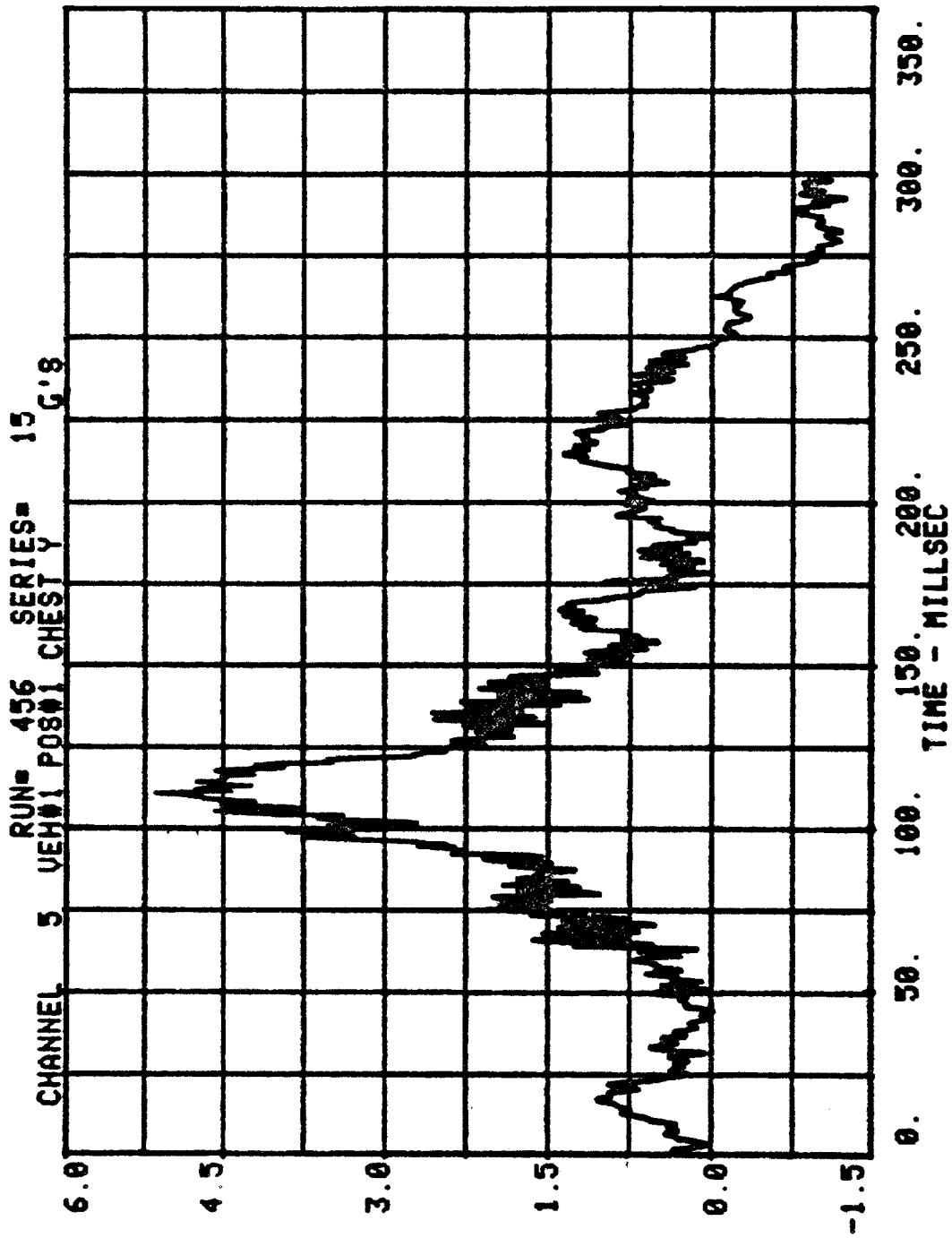

CHANNEL 1
RUN= 456 SERIES= 15
VEH#1 POS#1 HEAD X G'S
16
8
0
-8
-16
-24
0.
50.
100.
150.
200.
250.
300.
350.
TIME MILLISEC

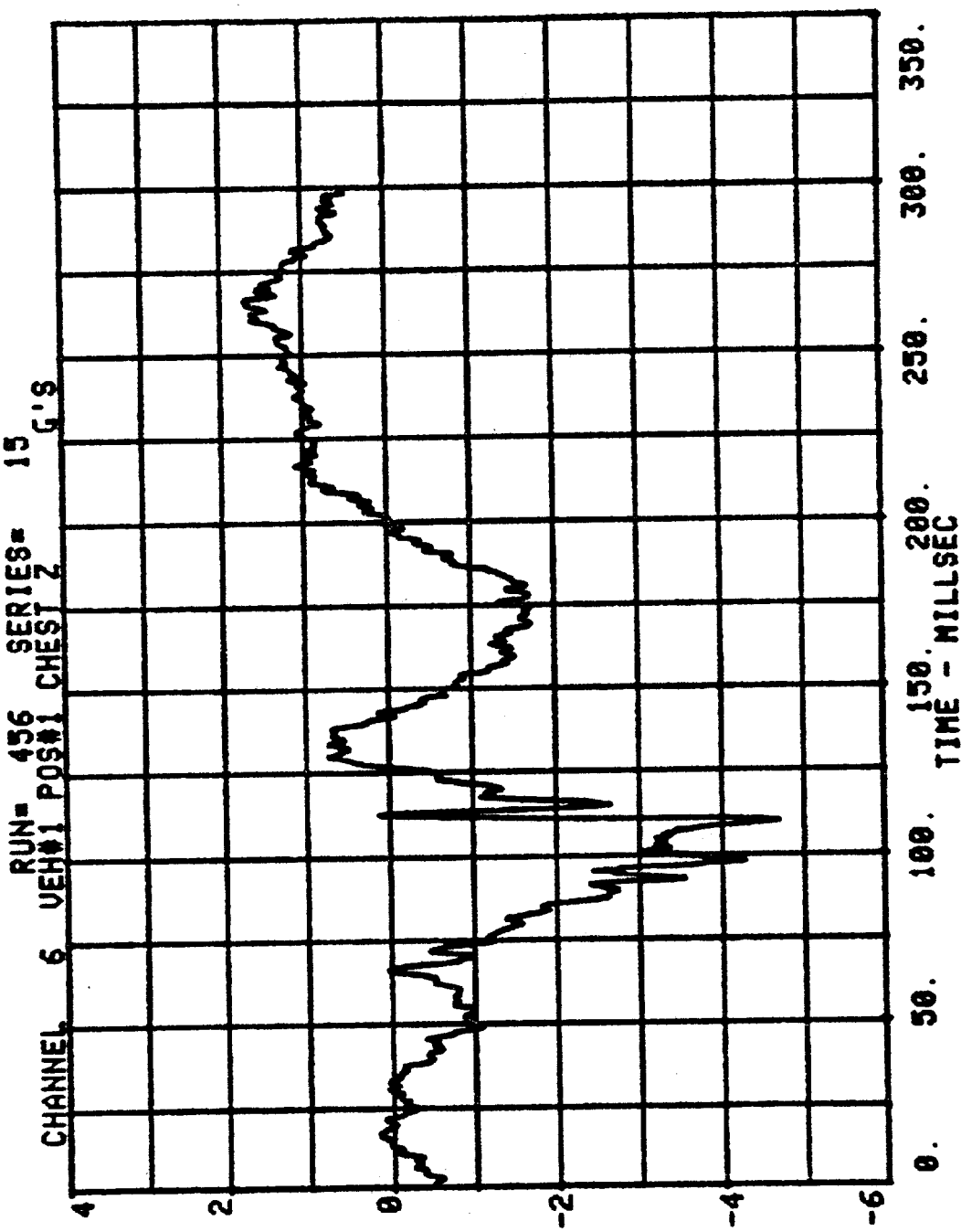

CHANNEL 2 VEHØ1 POSØ1 HEAD Y
RUN= 456 SERIES= 15
G'S
4
3
2
1
0
-1
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

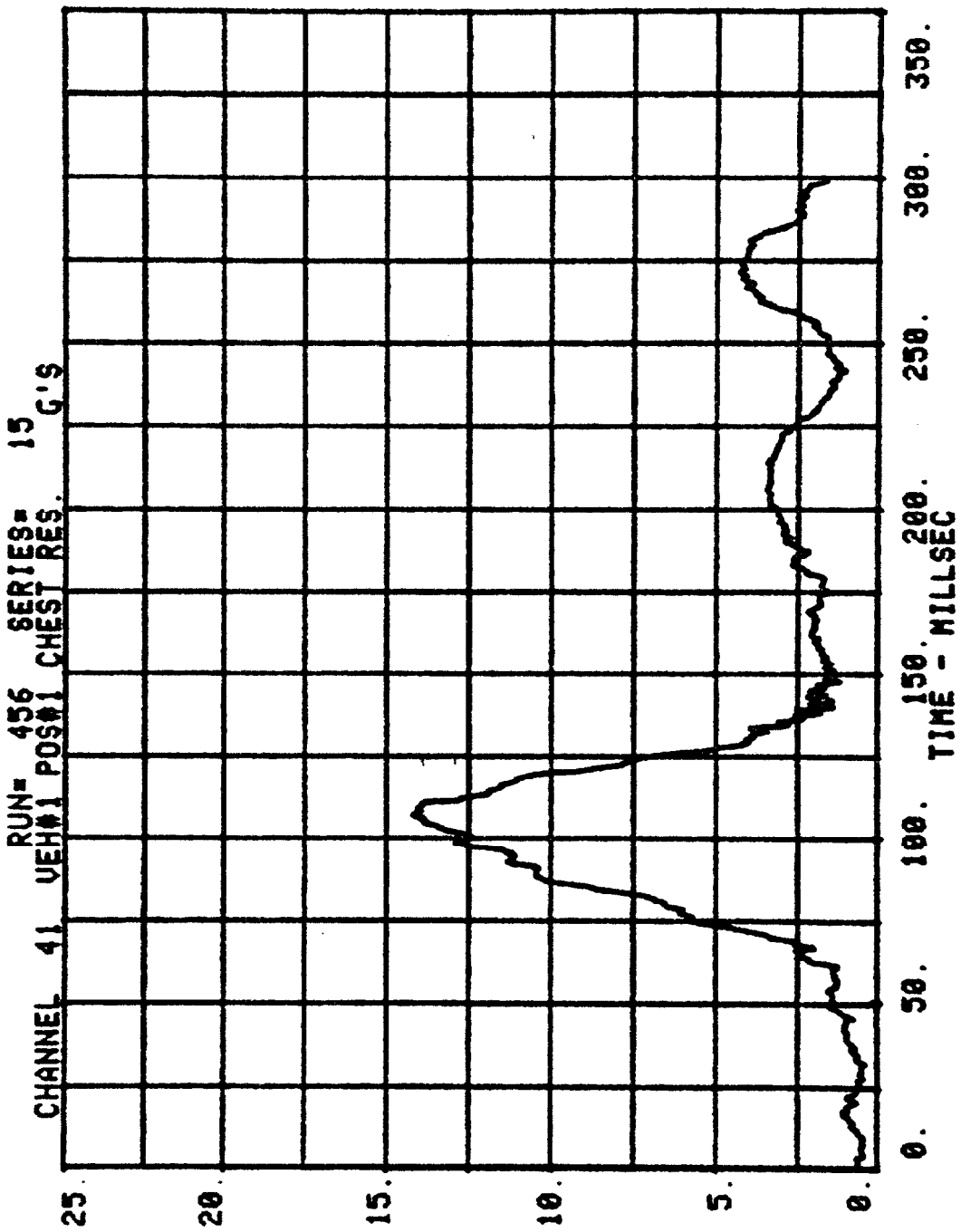

CHANNEL 3 VEH#1 POS#1 HEAD 2
RUN= 456 SERIES= 15 G'8
16
12
8
4
0
-4
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

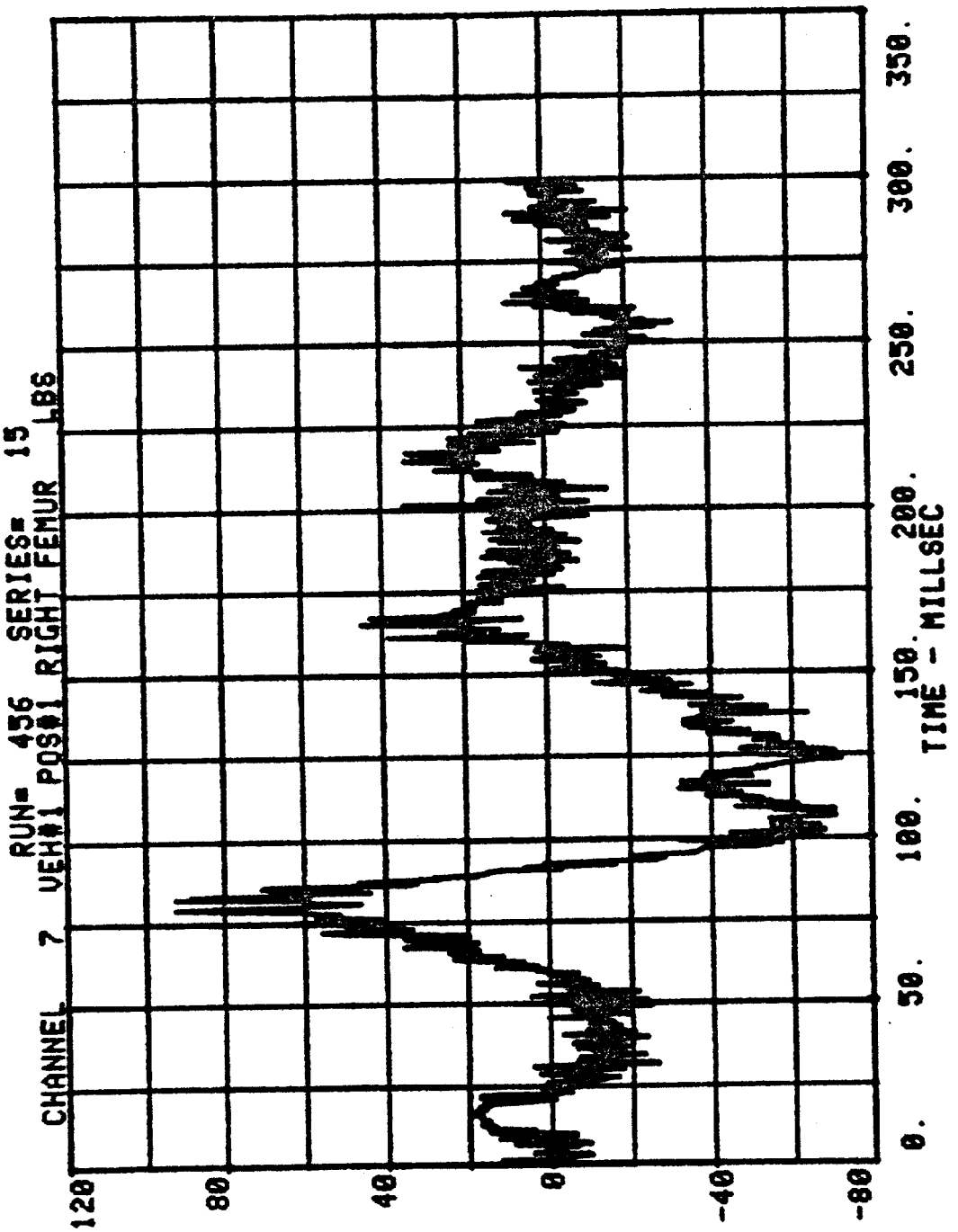

CHANNEL 40 VEH#1 POS#1 HEAD RES.
RUN= 456 SERIES= 15
G'S
25.
20.
15.
10.
5.
0.
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

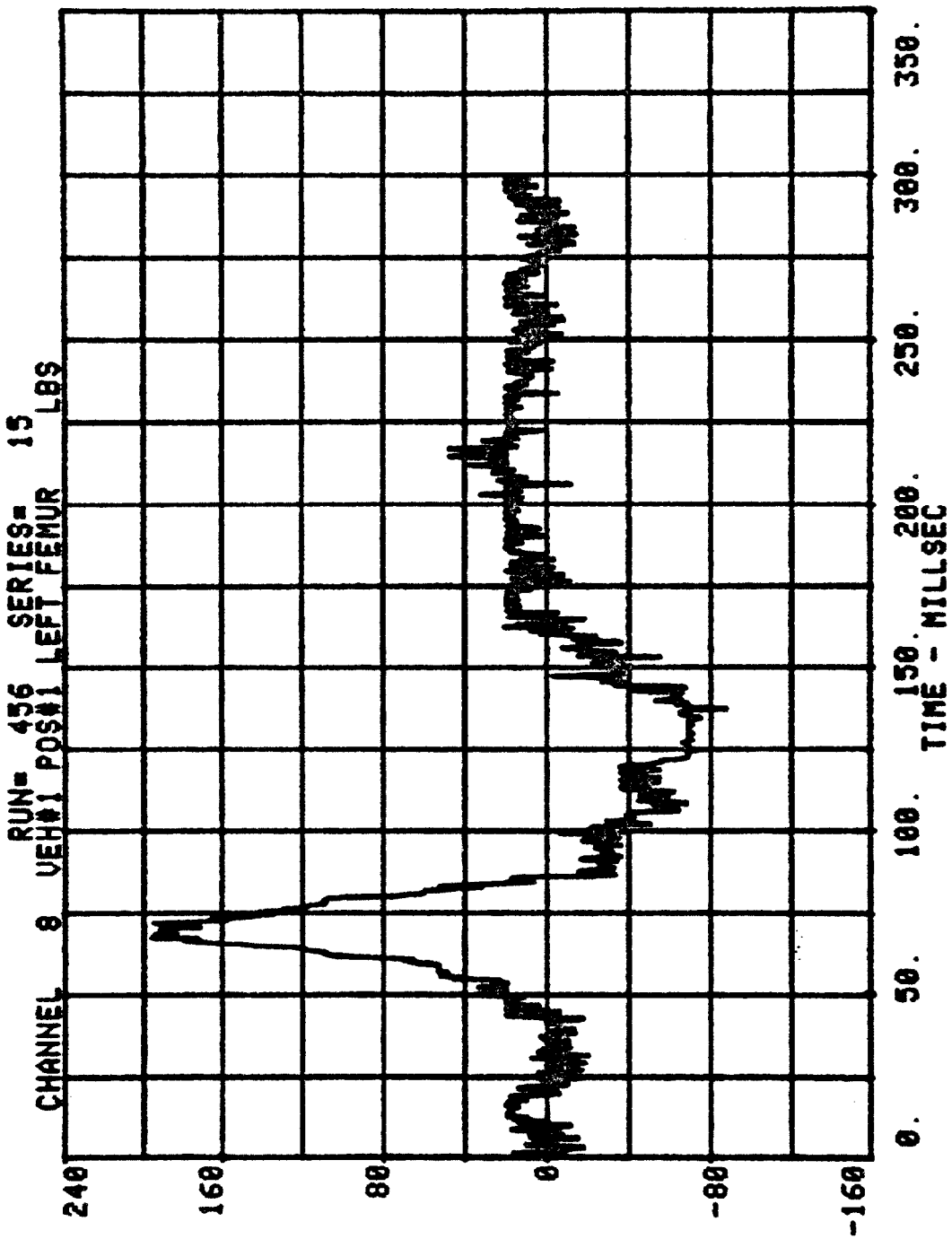

CHANNEL 4 RUN= 456 SERIES= 15
VEHI POSNI CHEST X
G'S
4
0
-4
-8
-12
-16
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

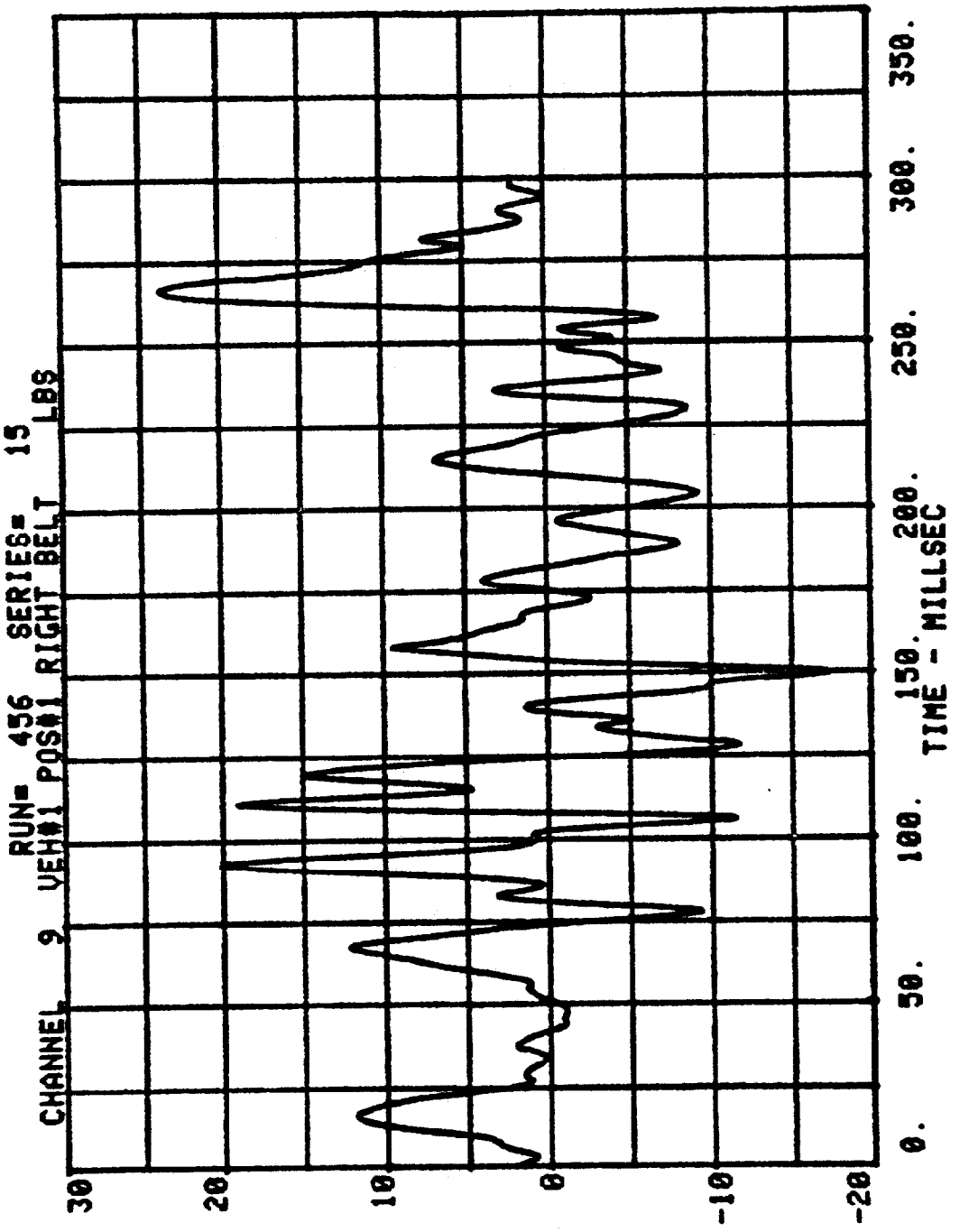

CHANNEL 5 VEH#1 POS#1 CHEST Y
RUN= 456 SERIES= 15 G'S
6.0
4.5
3.0
1.5
0.0
-1.5
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

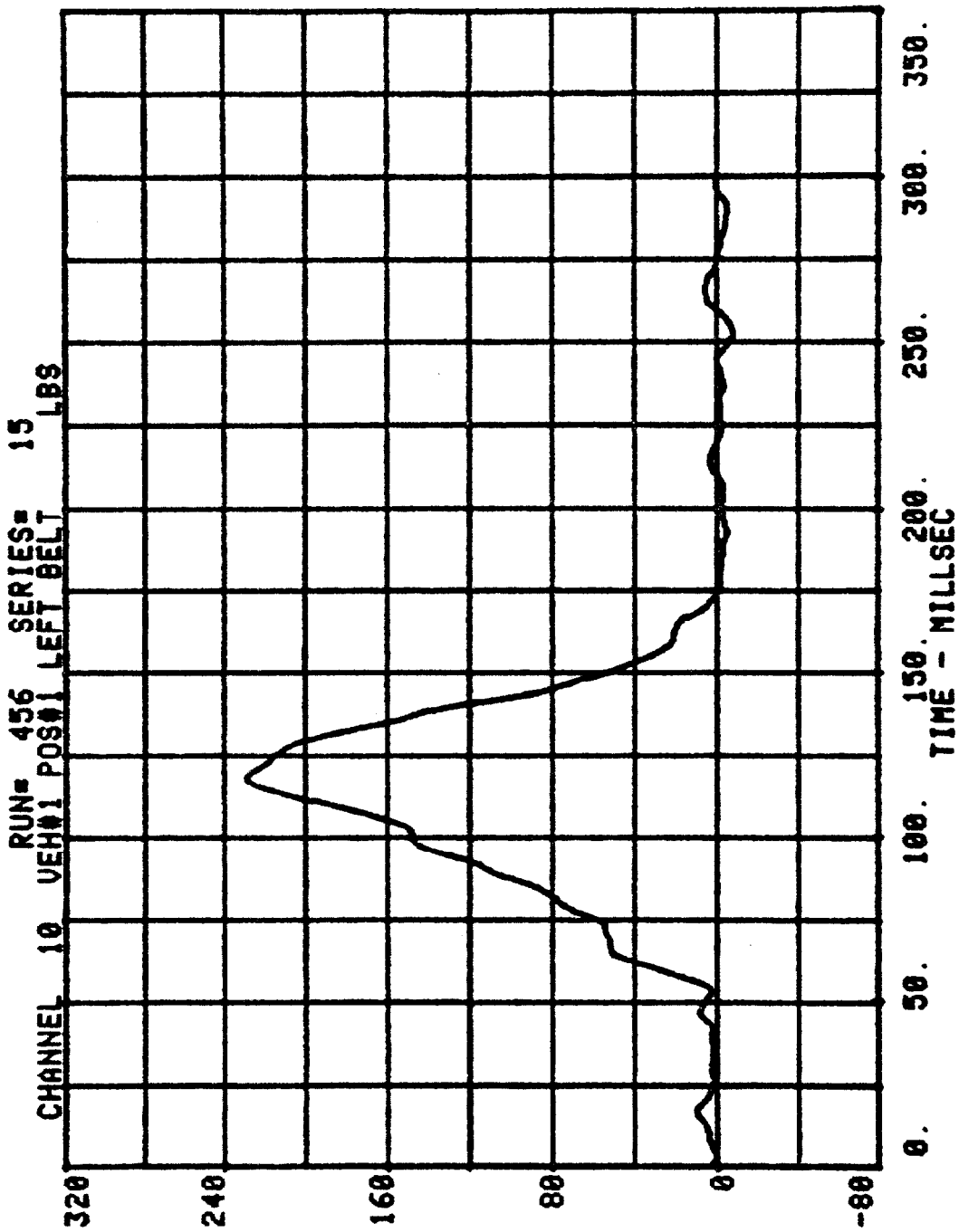

CHANNEL 6 VEH#1 POS#1 CHEST Z
RUN= 456 SERIES= 15 G'S
4
2
0
-2
-4
-6
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

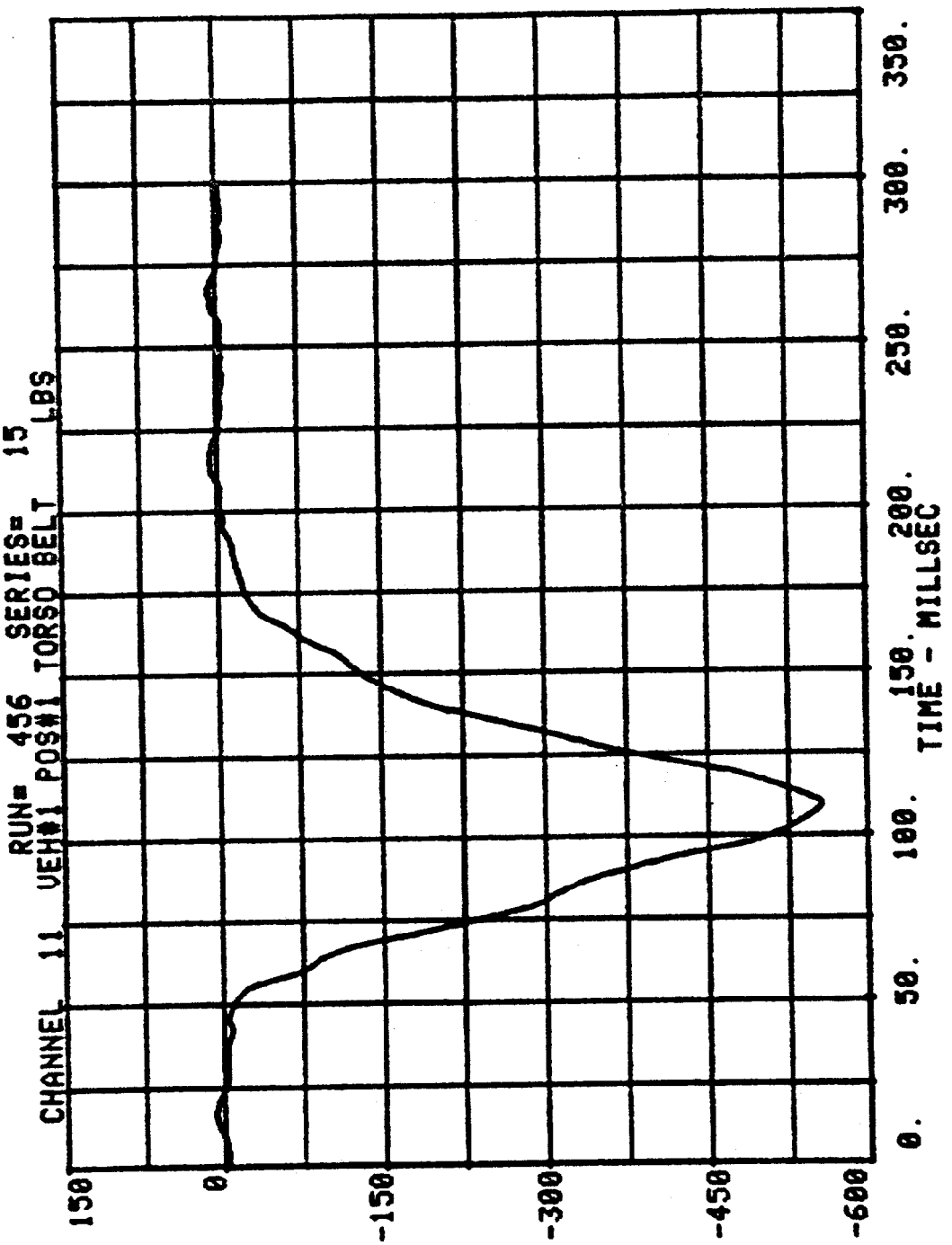

CHANNEL 41 VEH#1 POS#1 CHEST RES.
RUN= 456 SERIES= 15
G'S
25.
20.
15.
10.
5.
0.
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 7 VEH#1 POS#1 RIGHT FEMUR
RUN= 456 SERIES= 15
LBS
120
80
40
0
-40
-80
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 8 RUN= 456 SERIES= 15
VEH#1 POS#1 LEFT FEMUR LBS
240
160
80
0
-80
-160
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 9 VEH#1 POS#1 RIGHT BELT
RUN= 456 SERIES= 15 LBS
30
20
10
0
-10
-20
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

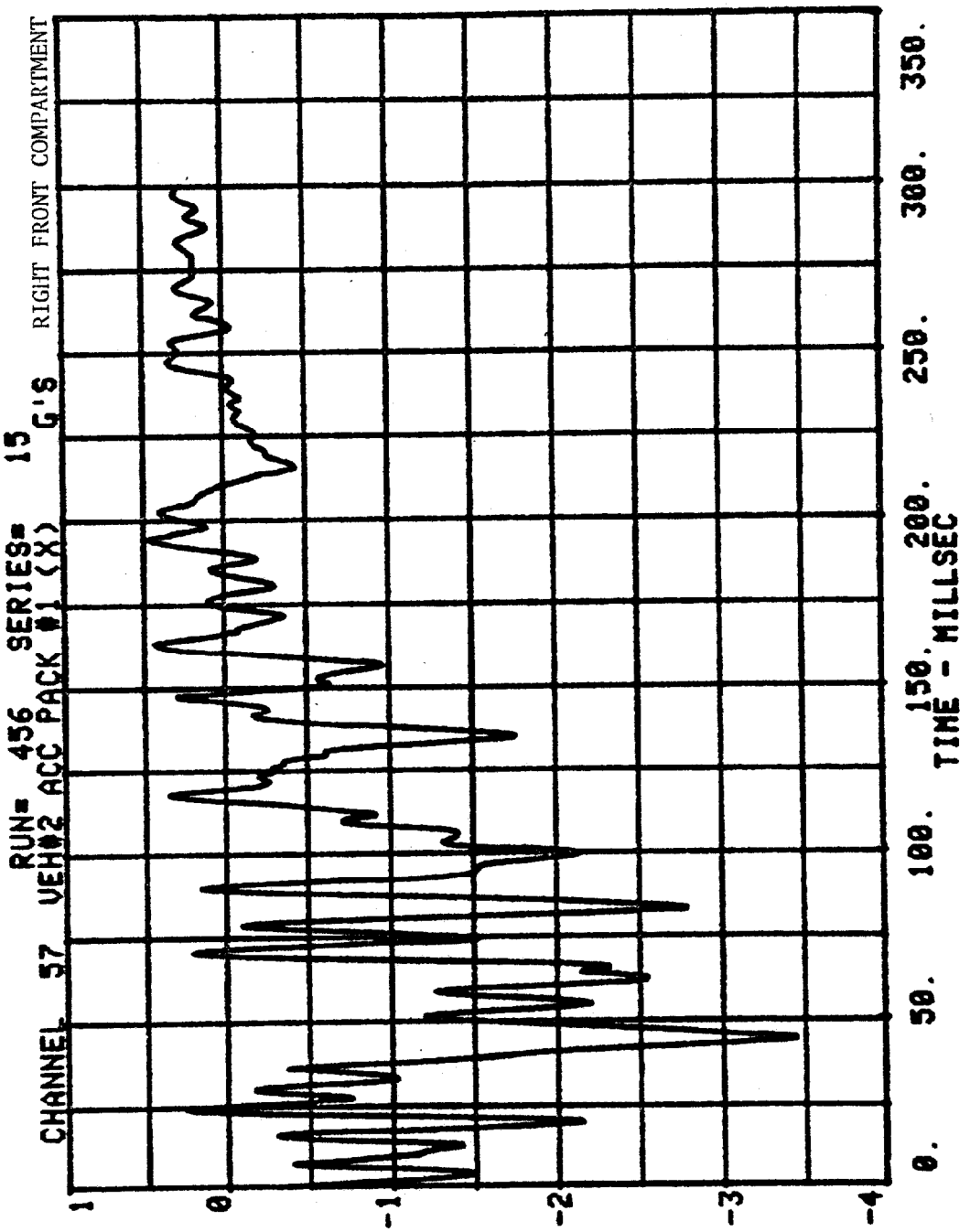

CHANNEL 10 VEH#1 POS#1 LEFT BELT
RUN= 456 SERIES= 15 LBS
320
240
160
80
0
-80
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

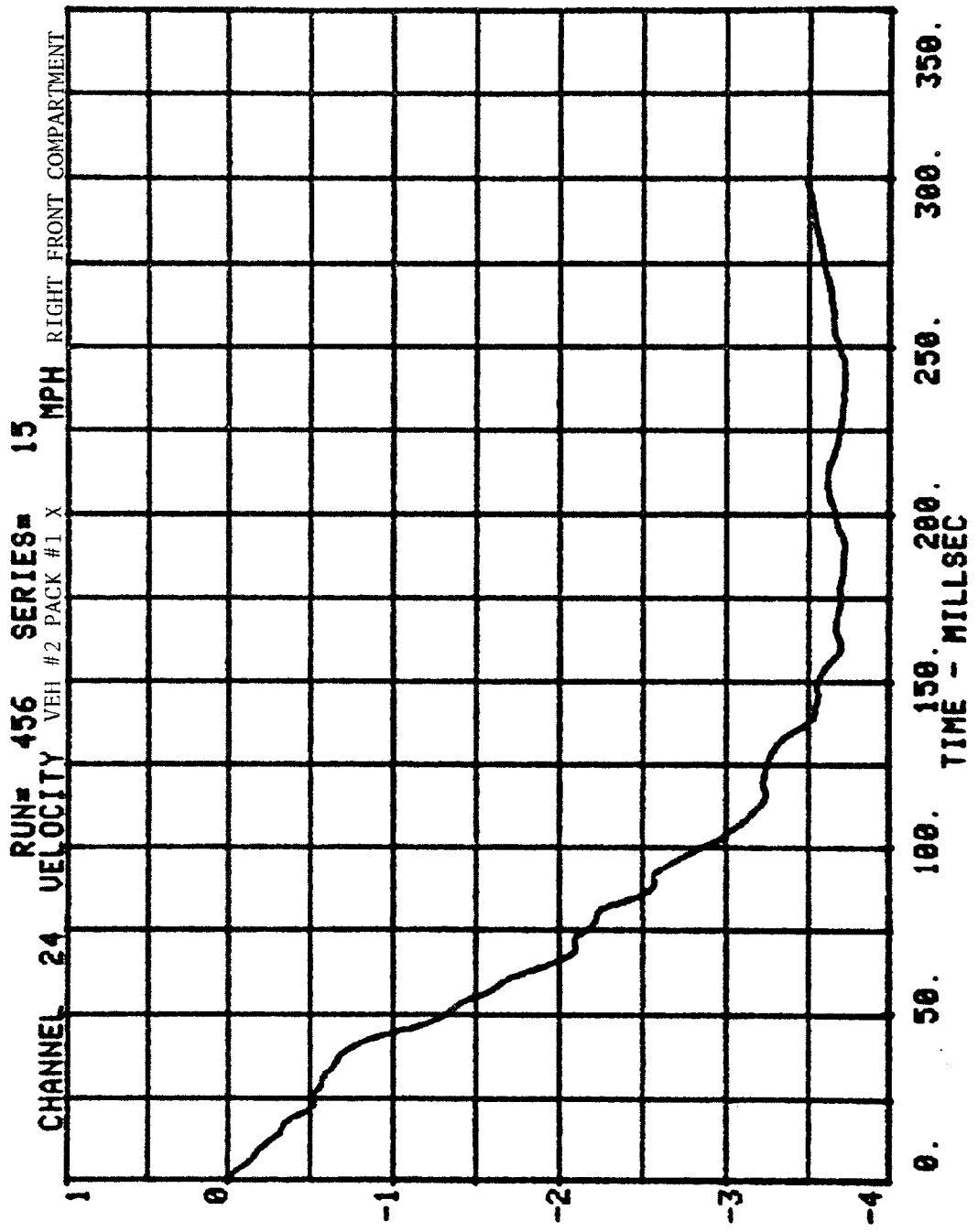

CHANNEL 11 VEH#1 POS#1 TORSO BELT
RUN= 456 SERIES= 15 LBS
150
0
-150
-300
-450
-600
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

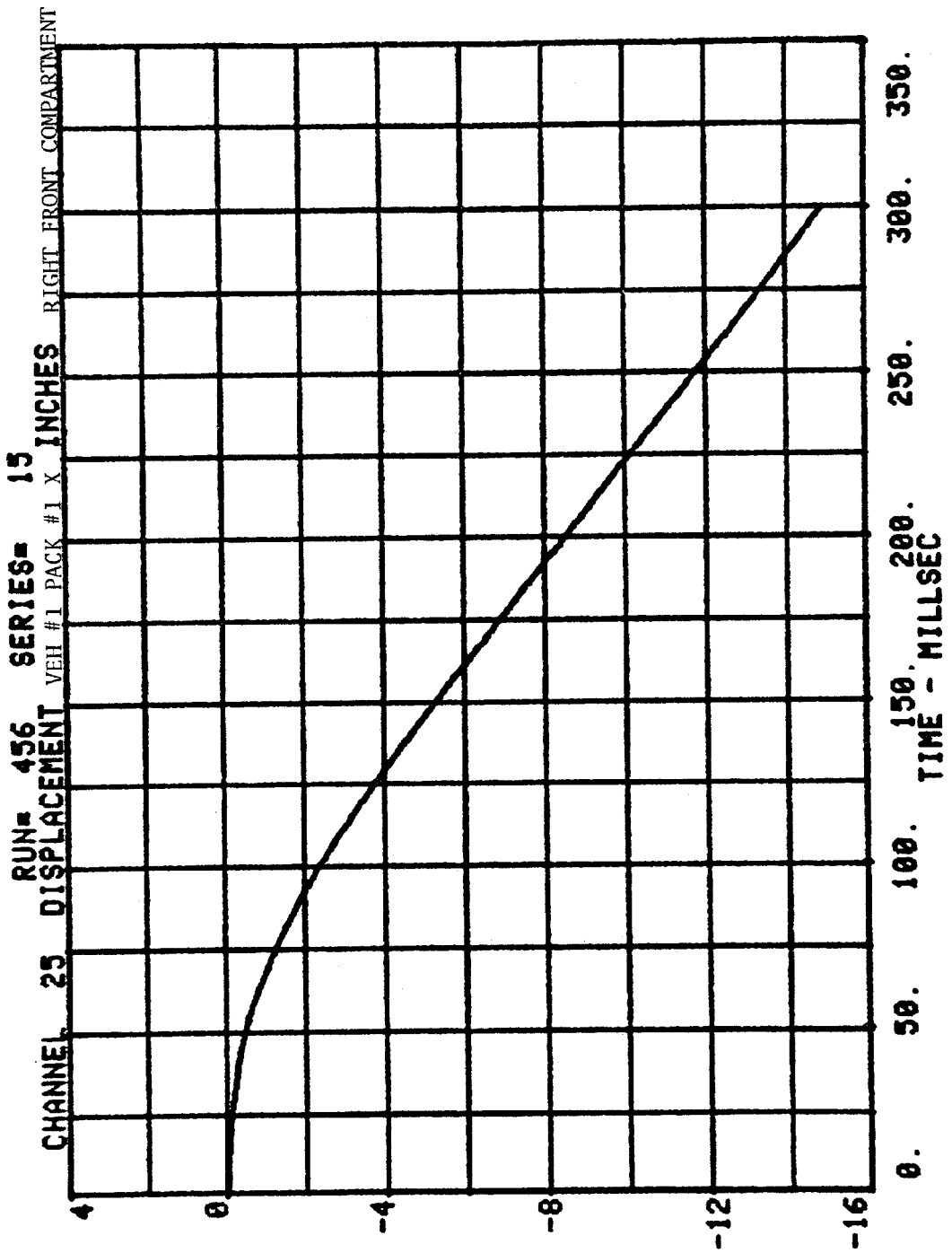
TEST NO. 14

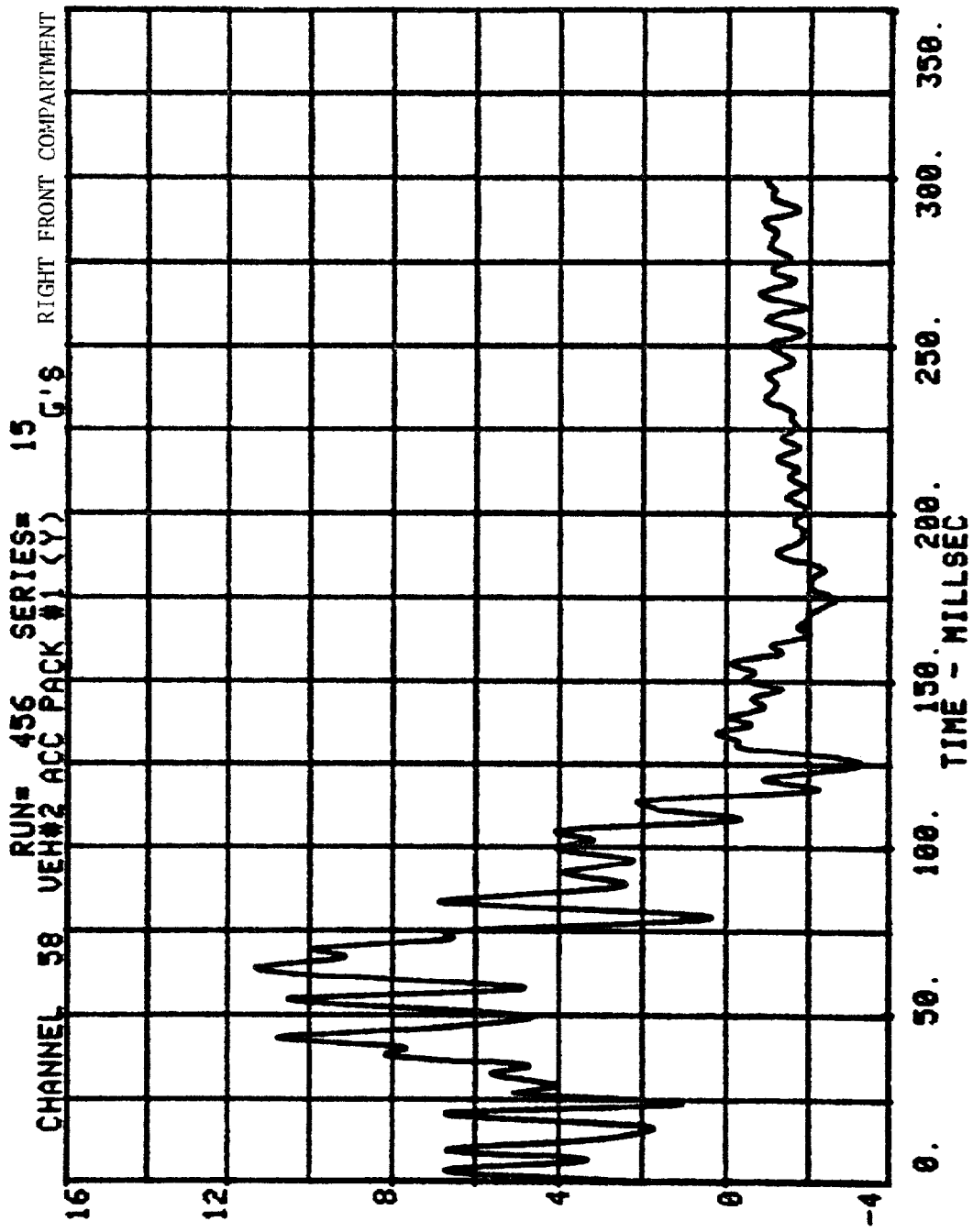
VEHICLE NO. 2 - 1976 VW RABBIT (MODIFIED)

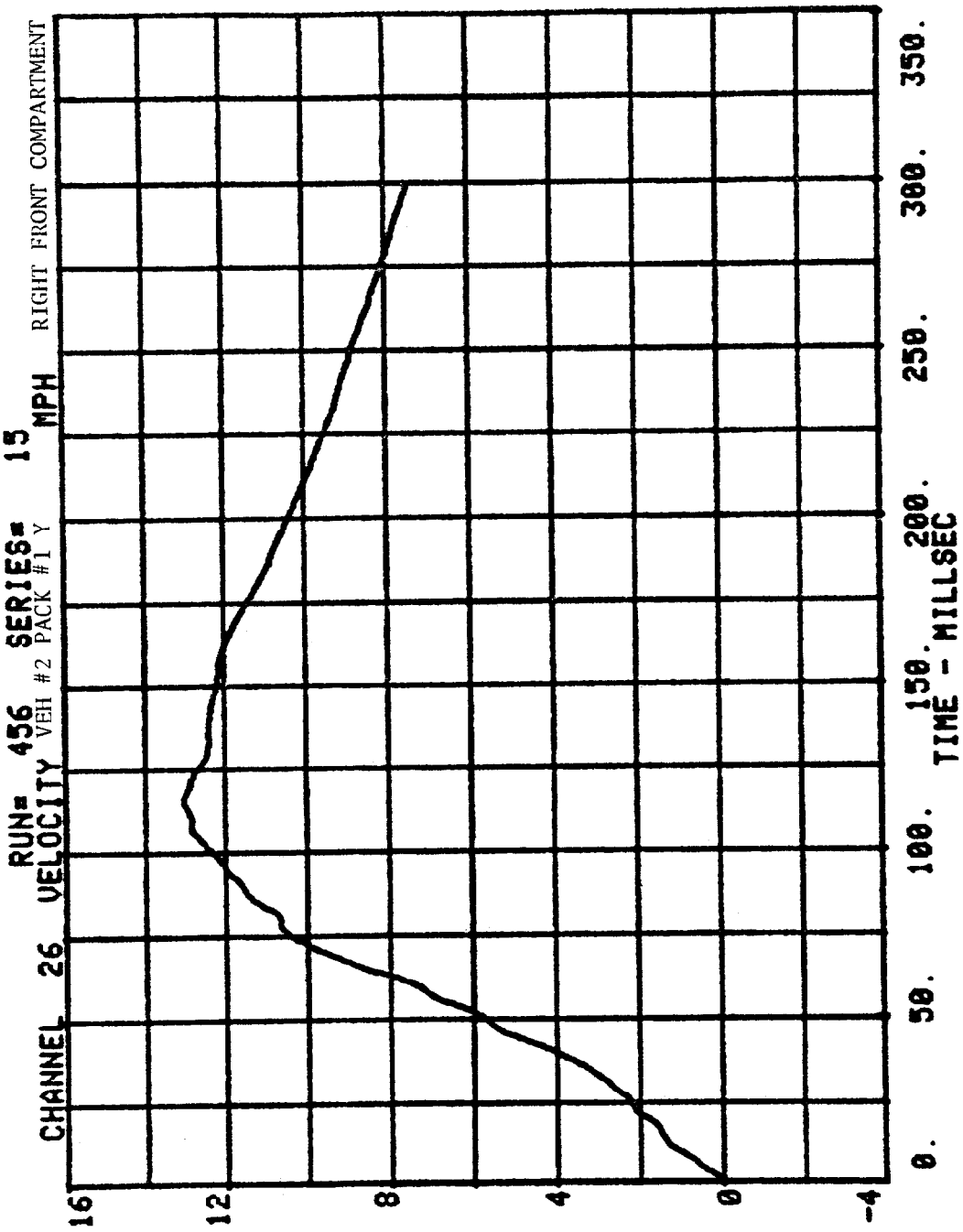
	Channel Filter Class
Accelerations	60 Hz

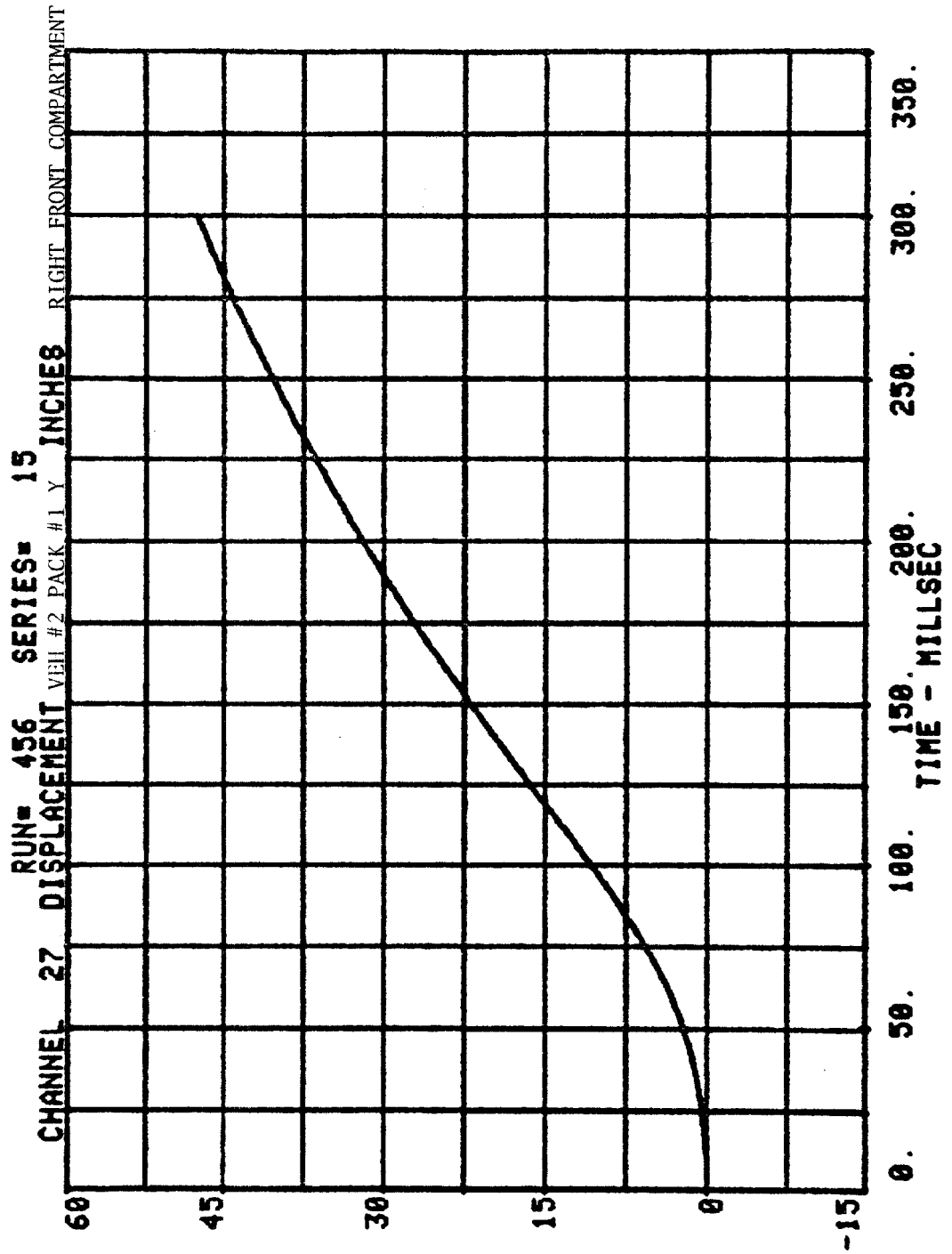

CHANNEL 57 RUN= 456 SERIES= 15
VEH#2 ACC PACK #1 (X) G'S
RIGHT FRONT COMPARTMENT
1
0
-1
-2
-3
-4
0.
50.
100.
150.
200.
250.
300.
350.
TIME = MILLSEC

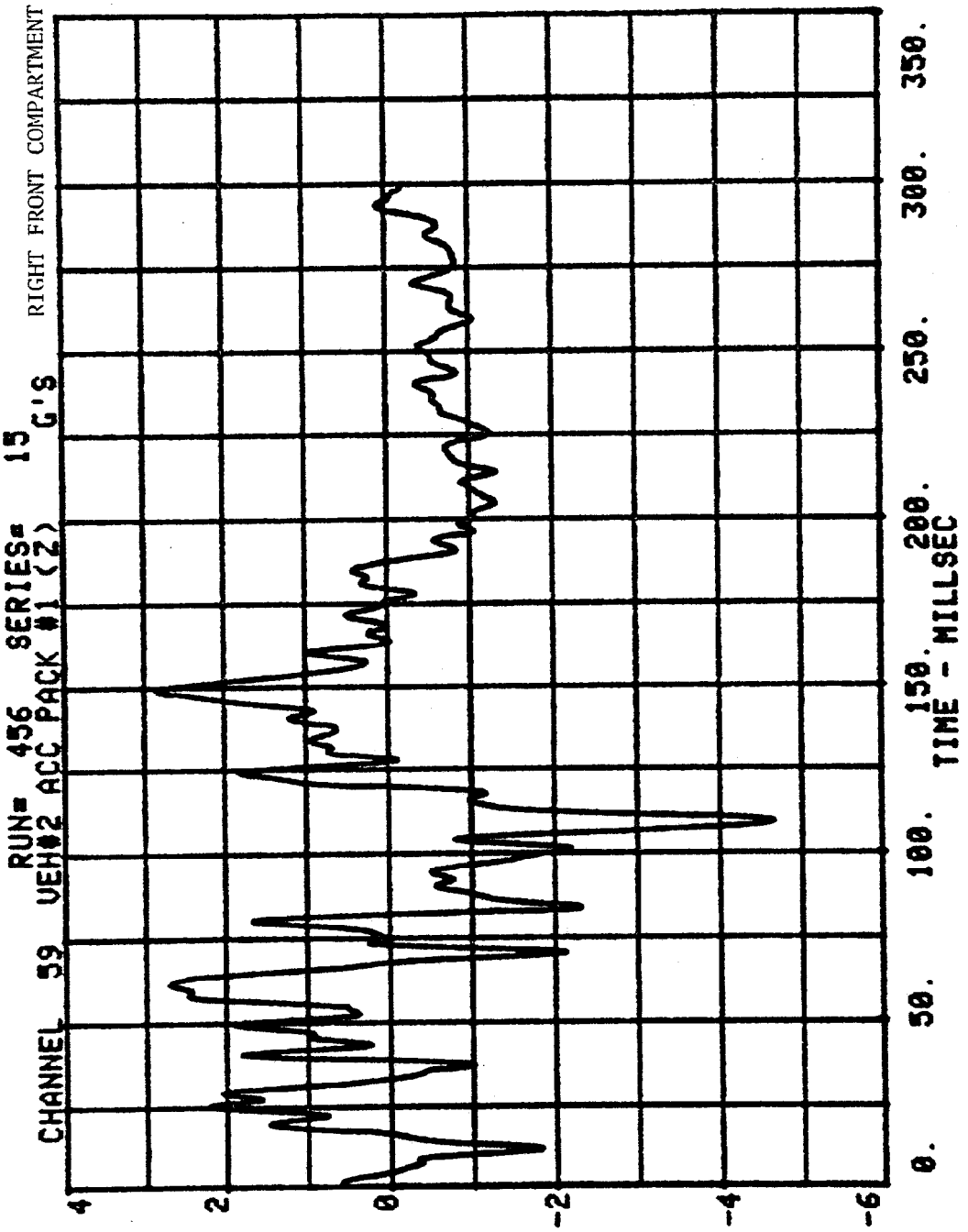

CHANNEL 24 VELOCITY
RUN= 456 SERIES= 15 MPH
VEH #2 PACK #1 X
RIGHT FRONT COMPARTMENT
1
0
-1
-2
-3
-4
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

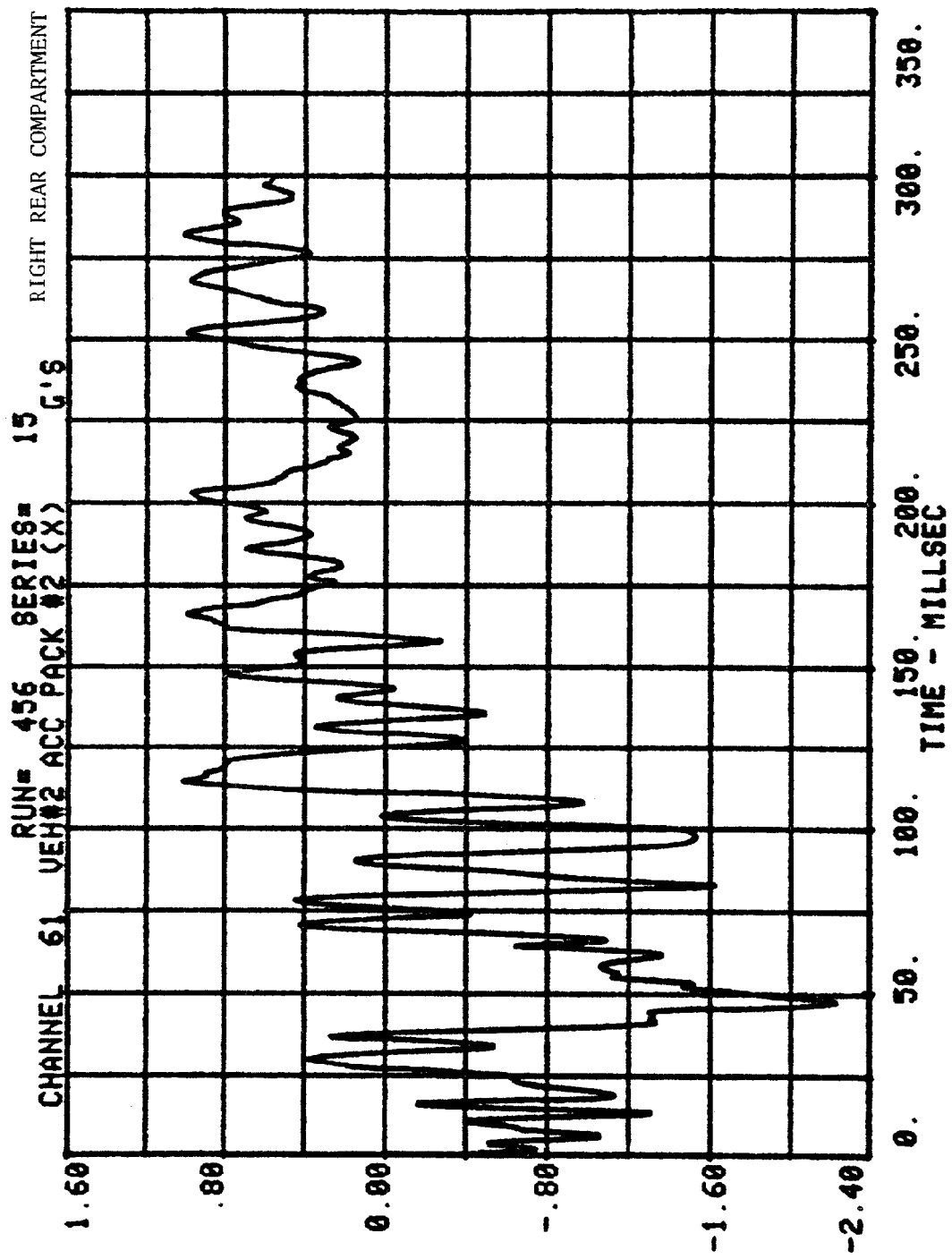

CHANNEL 25 DISPLACEMENT
RUN= 456 SERIES= 15
VEH #1 PACK #1 X INCHES
RIGHT FRONT COMPARTMENT
4
0
-4
-8
-12
-16
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

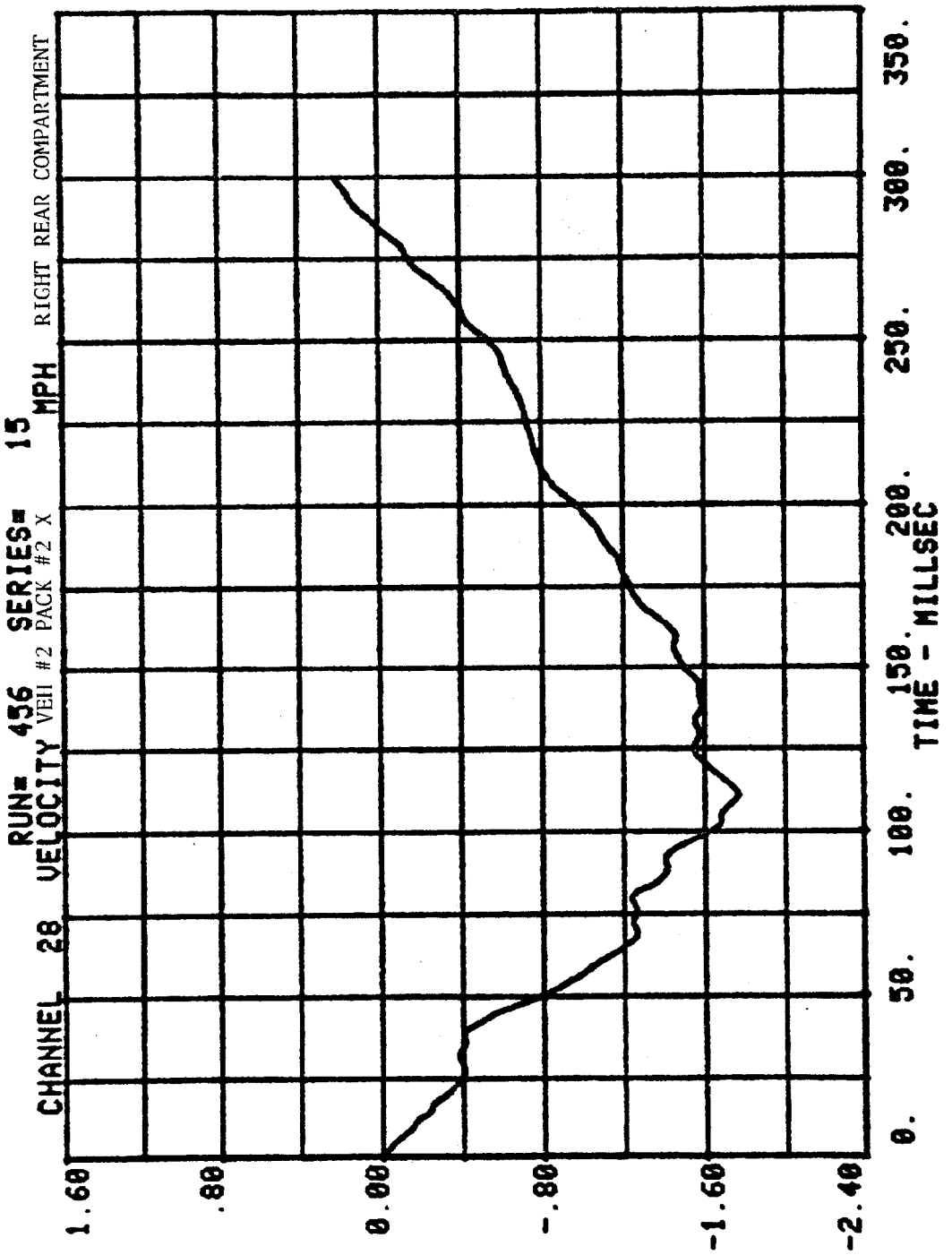

CHANNEL 58 RUN= 456 SERIES= 15
VEH#2 ACC PACK #1 (Y) G'S
RIGHT FRONT COMPARTMENT
16
12
8
4
0
-4
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

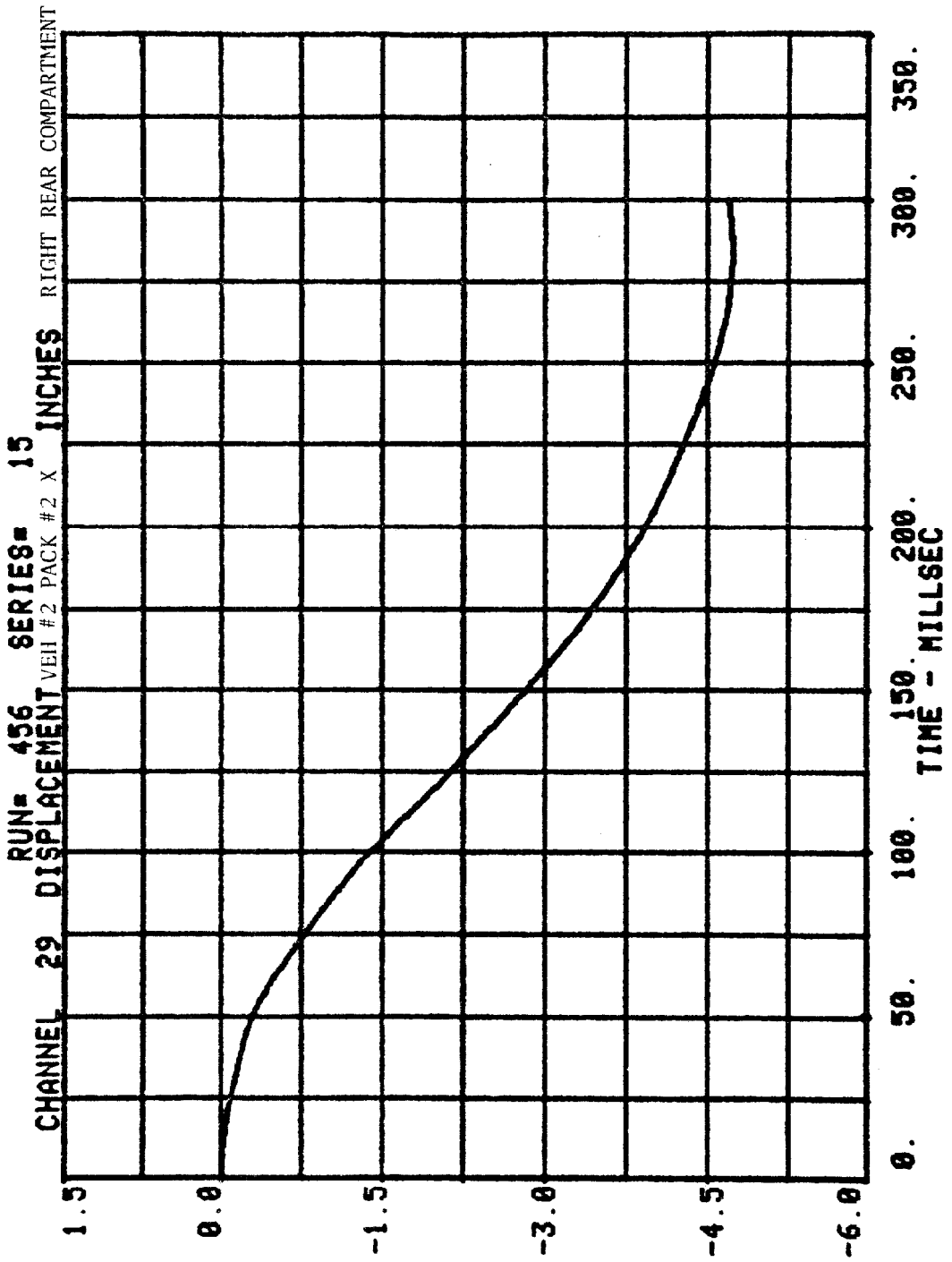

CHANNEL 26 VELOCITY
RUN= 456 SERIES= 15
VEH #2 PACK #1 Y
MPH
RIGHT FRONT COMPARTMENT
16
12
8
4
0
-4
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

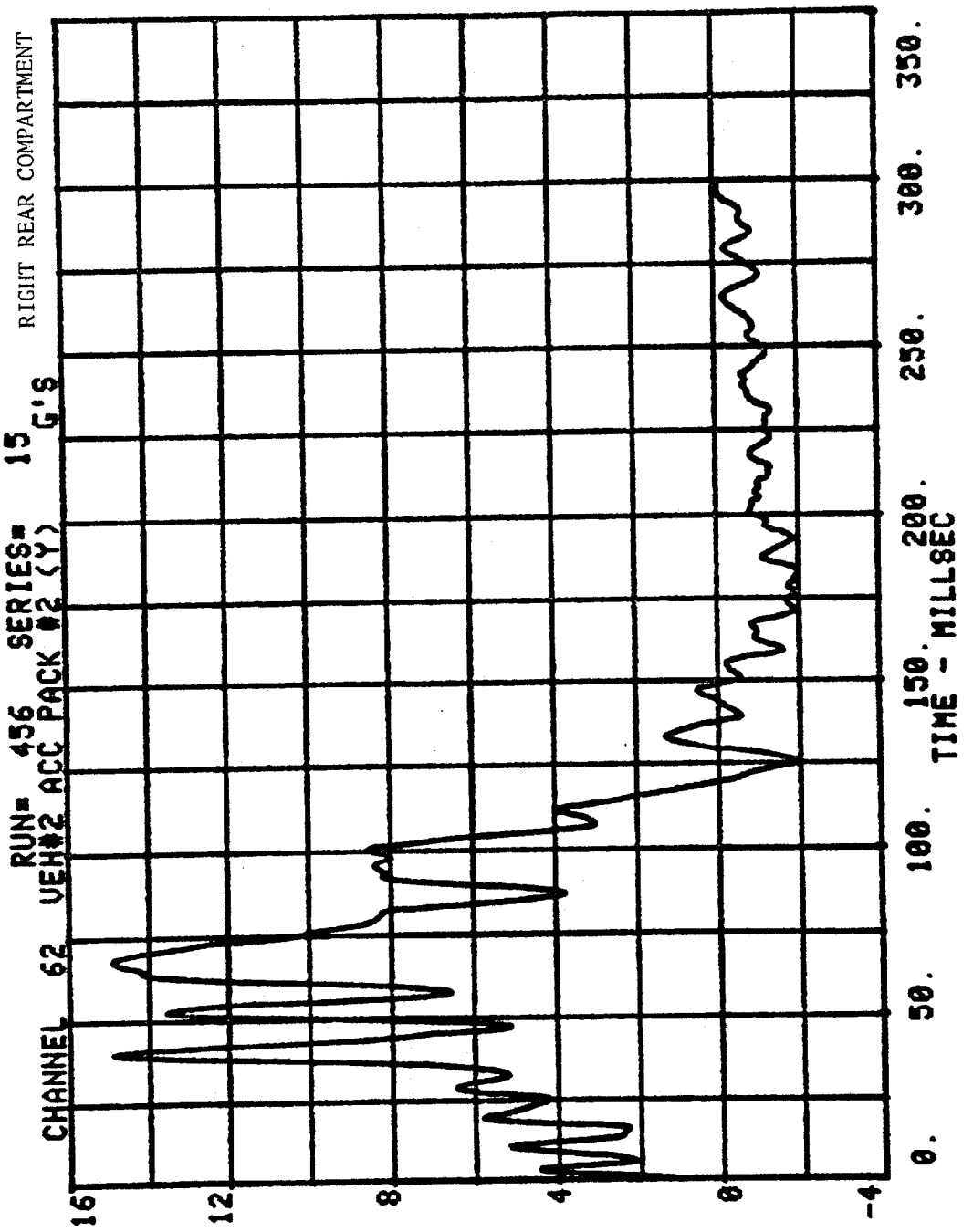

CHANNEL 27 RUN= 456 SERIES= 15
DISPLACEMENT VEH #2 PACK #1 Y INCHES RIGHT FRONT COMPARTMENT
60
45
30
15
0
-15
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

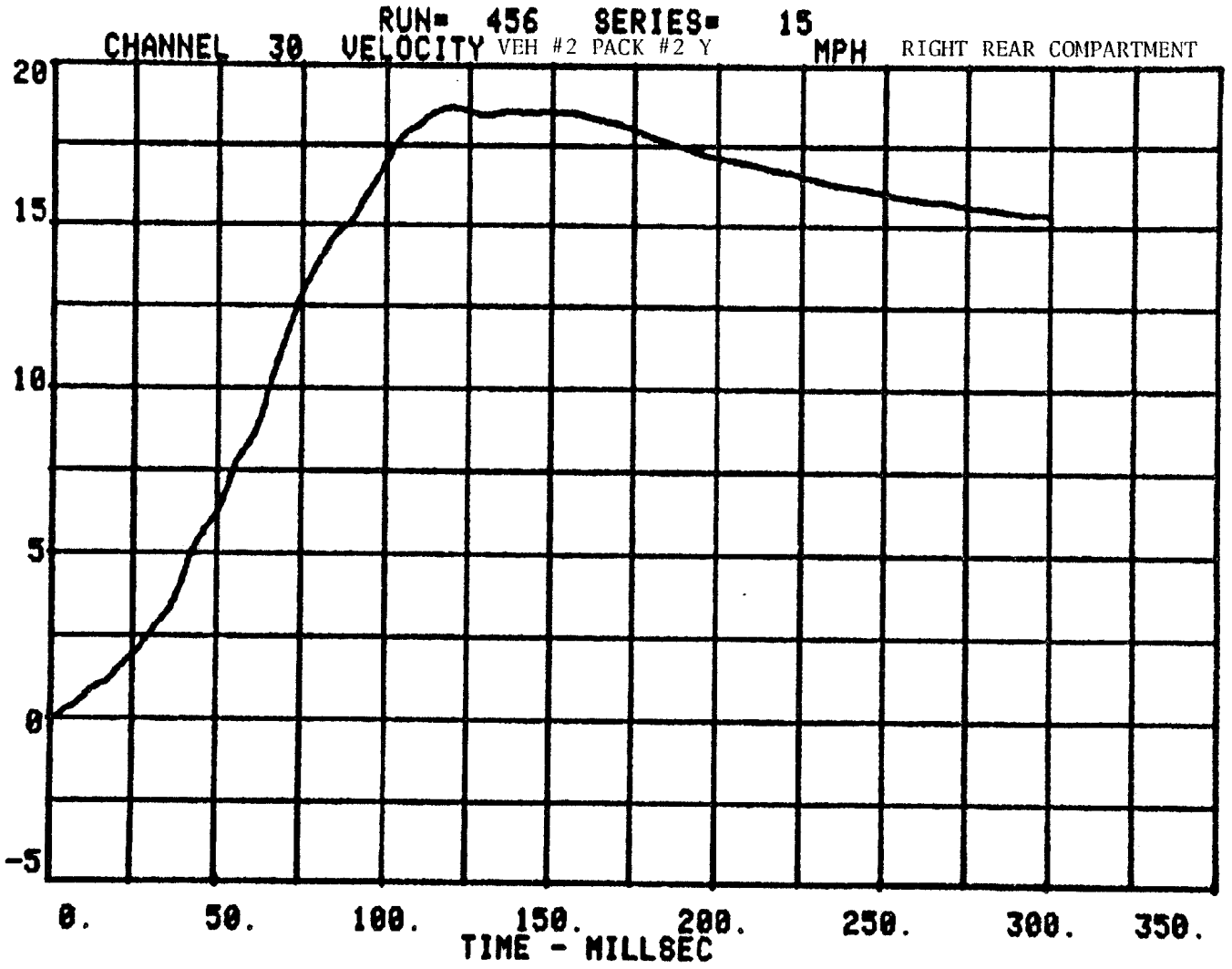

CHANNEL 59 VEH#2 ACC PACK #1 (Z)
RUN= 456 SERIES= 15 G'S
RIGHT FRONT COMPARTMENT
4
2
0
-2
-4
-6
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

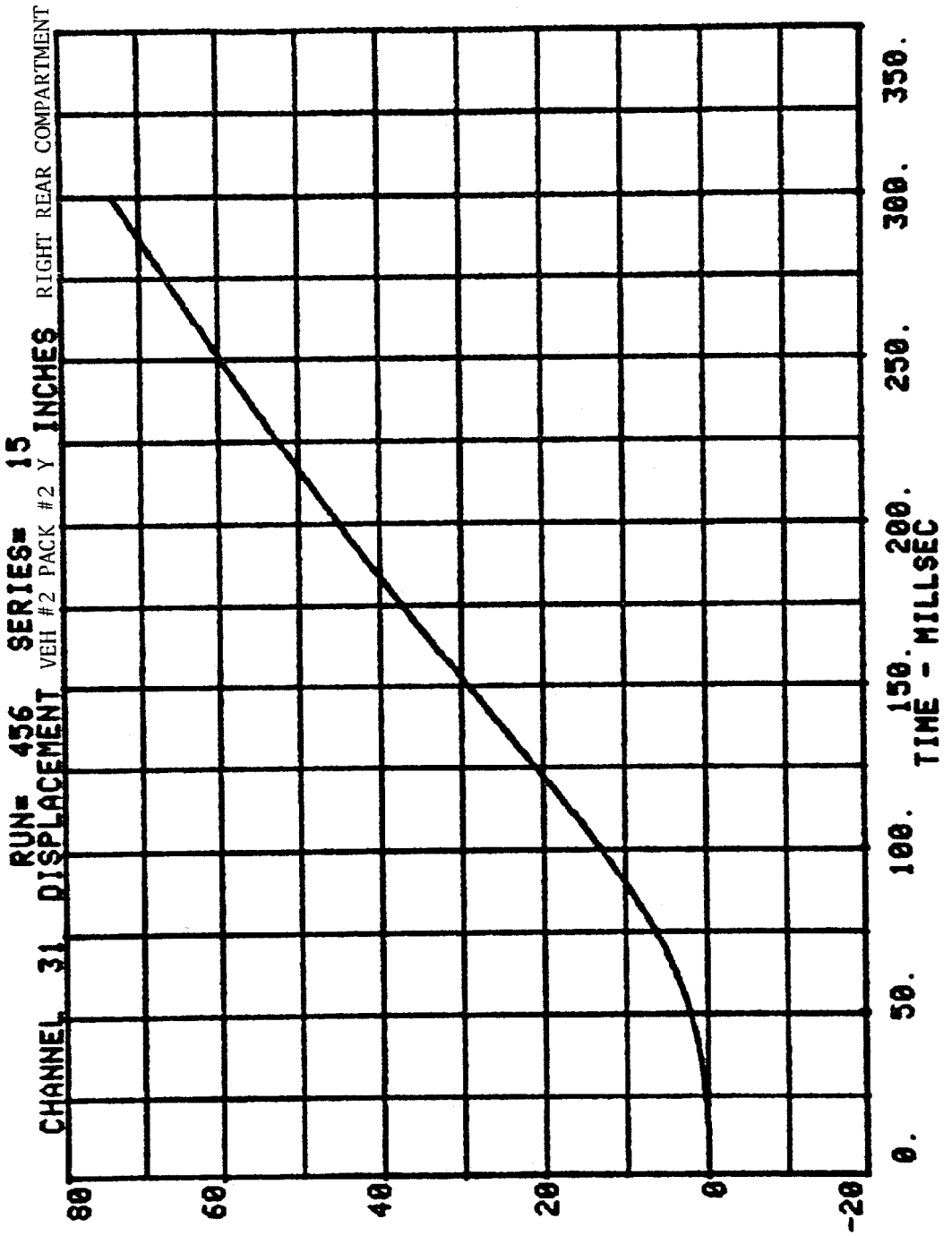

RIGHT REAR COMPARTMENT
CHANNEL 61 VEH#2 ACC PACK #2 (X) RUN= 456 SERIES= 15 G'S
1.60
.80
0.00
-.80
-1.60
-2.40
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

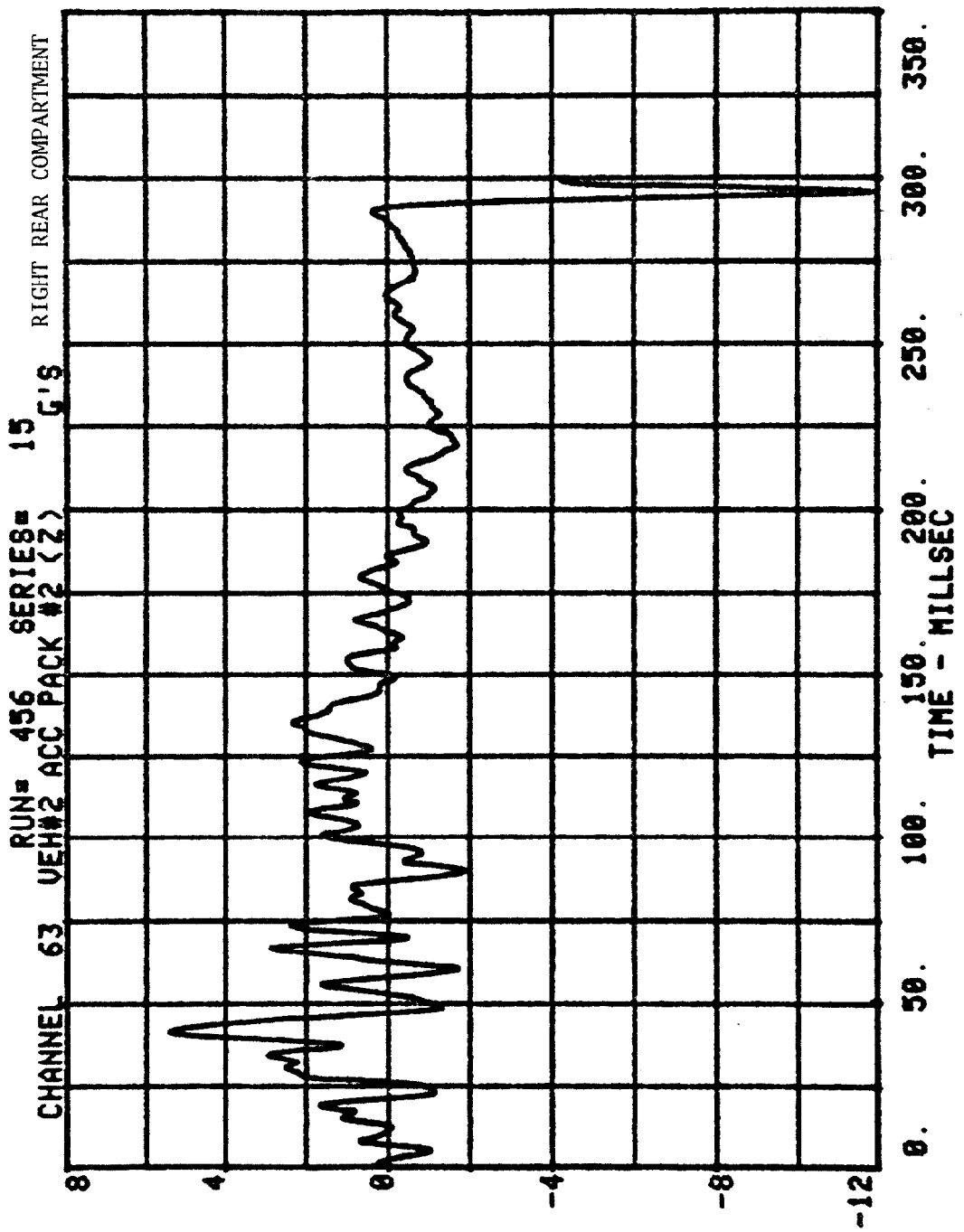

CHANNEL 28 VELOCITY RUN= 456 SERIES= 15
VEH #2 PACK #2 X MPH
RIGHT REAR COMPARTMENT
1.60
.80
0.00
-.80
-1.60
-2.40
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

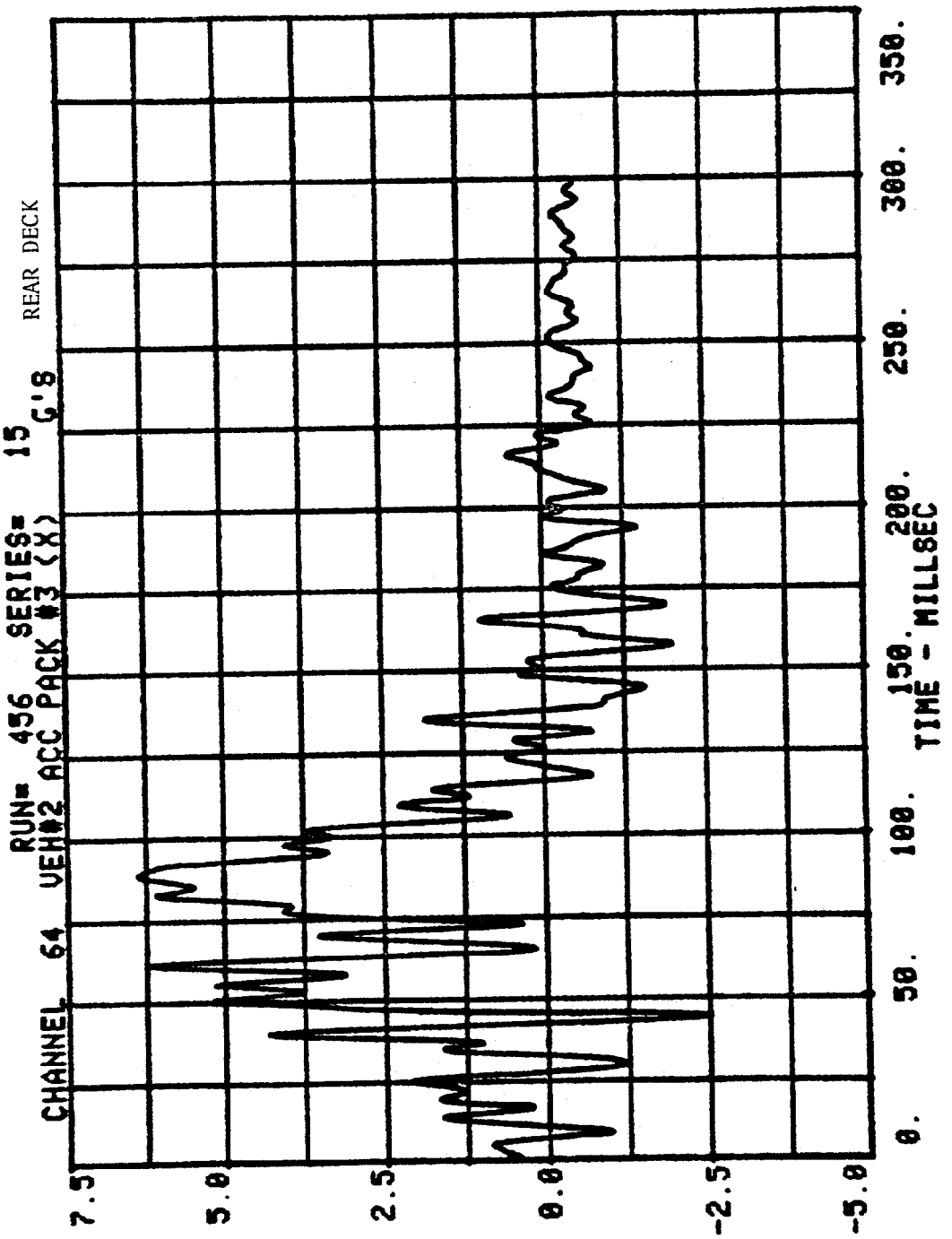

CHANNEL 29 DISPLACEMENT VEH #2 PACK #2 X INCHES RIGHT REAR COMPARTMENT
RUN= 456 SERIES= 15
1.5
0.0
-1.5
-3.0
-4.5
-6.0
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

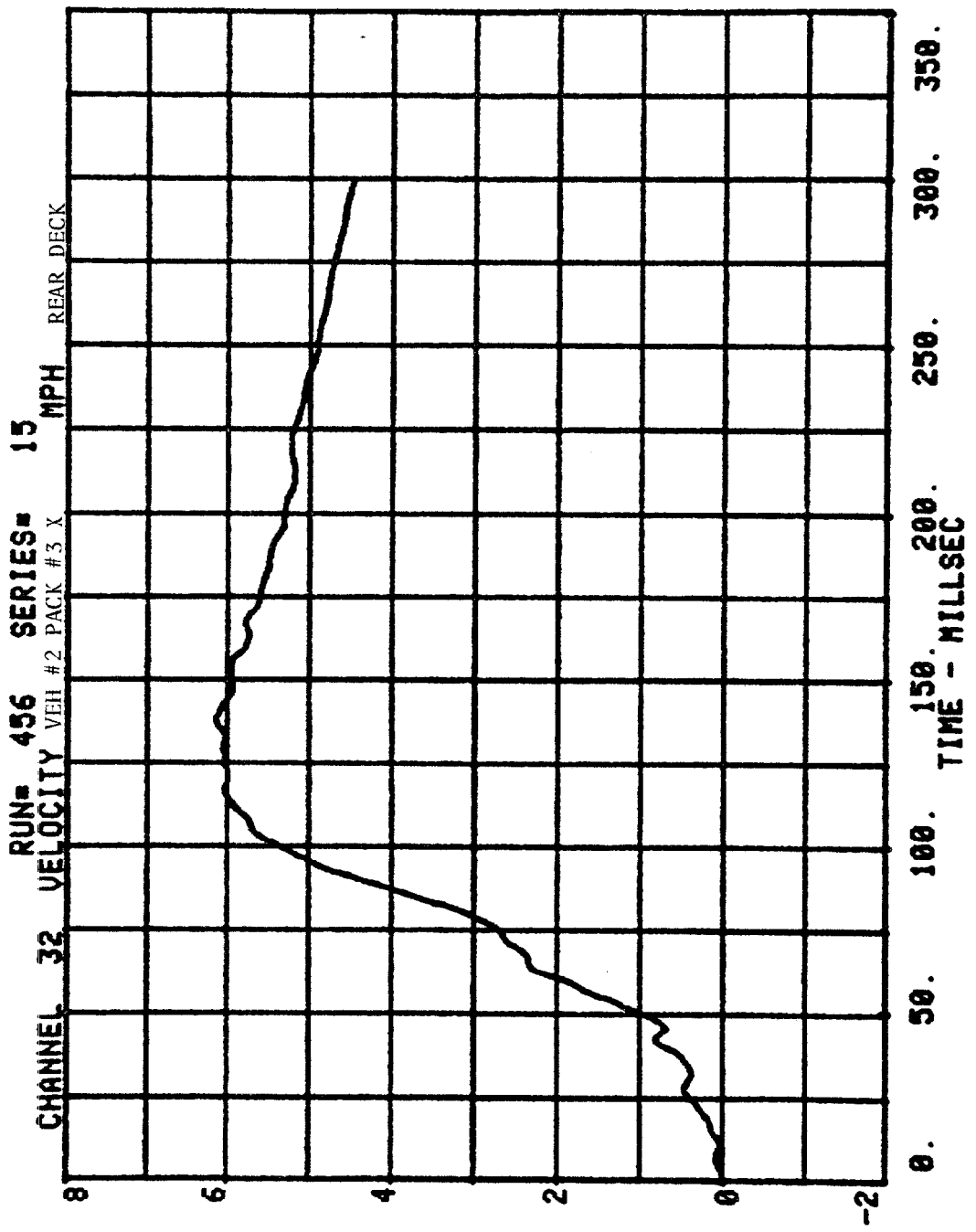

CHANNEL 62 VEH#2 ACC PACK #2 (Y)
RUN= 456 SERIES= 15 G'S
RIGHT REAR COMPARTMENT
16
12
8
4
0
-4
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

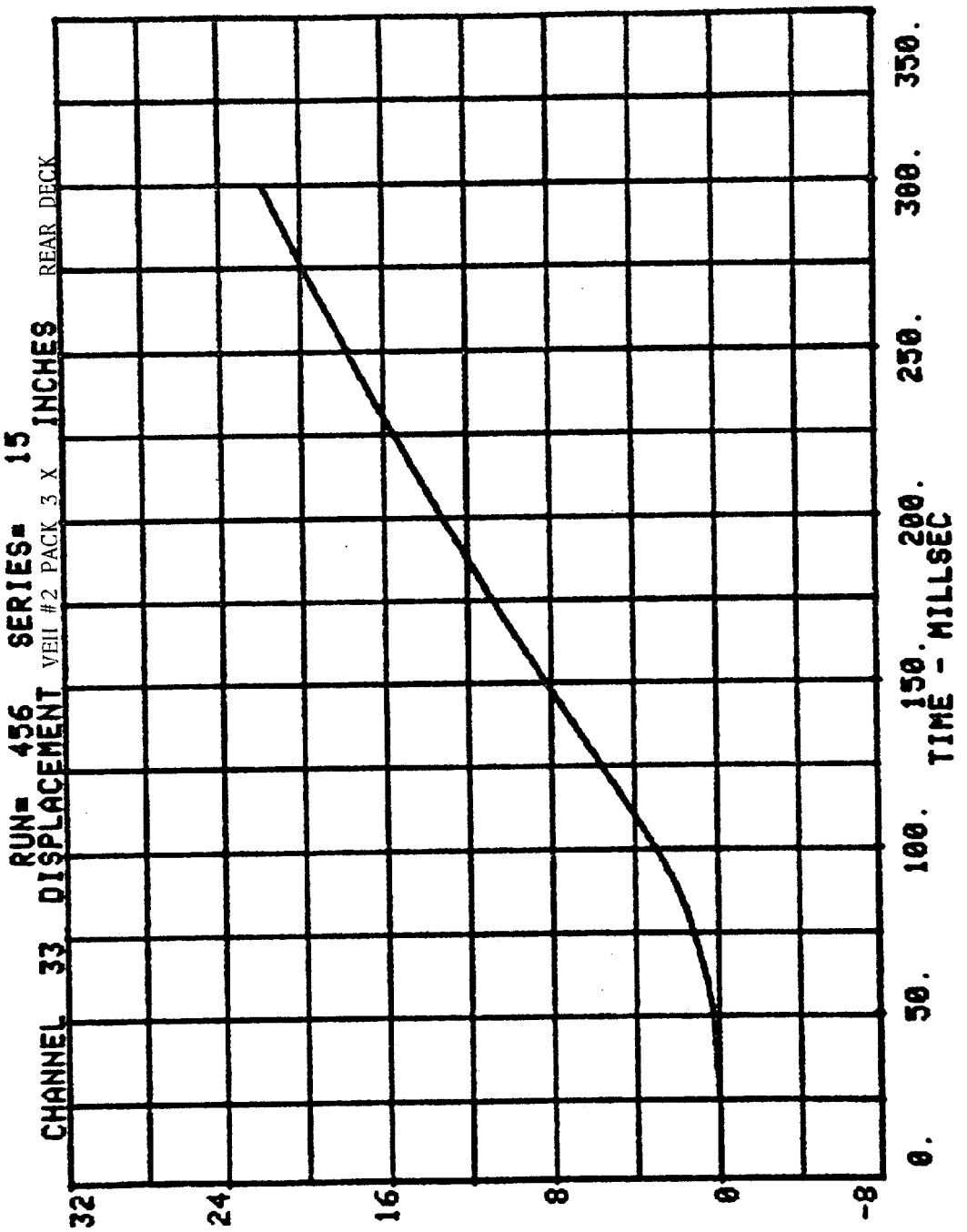

RUN= 456 SERIES= 15
CHANNEL 30 VELOCITY VEH #2 PACK #2 Y MPH RIGHT REAR COMPARTMENT
20
15
10
5
0
-5
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

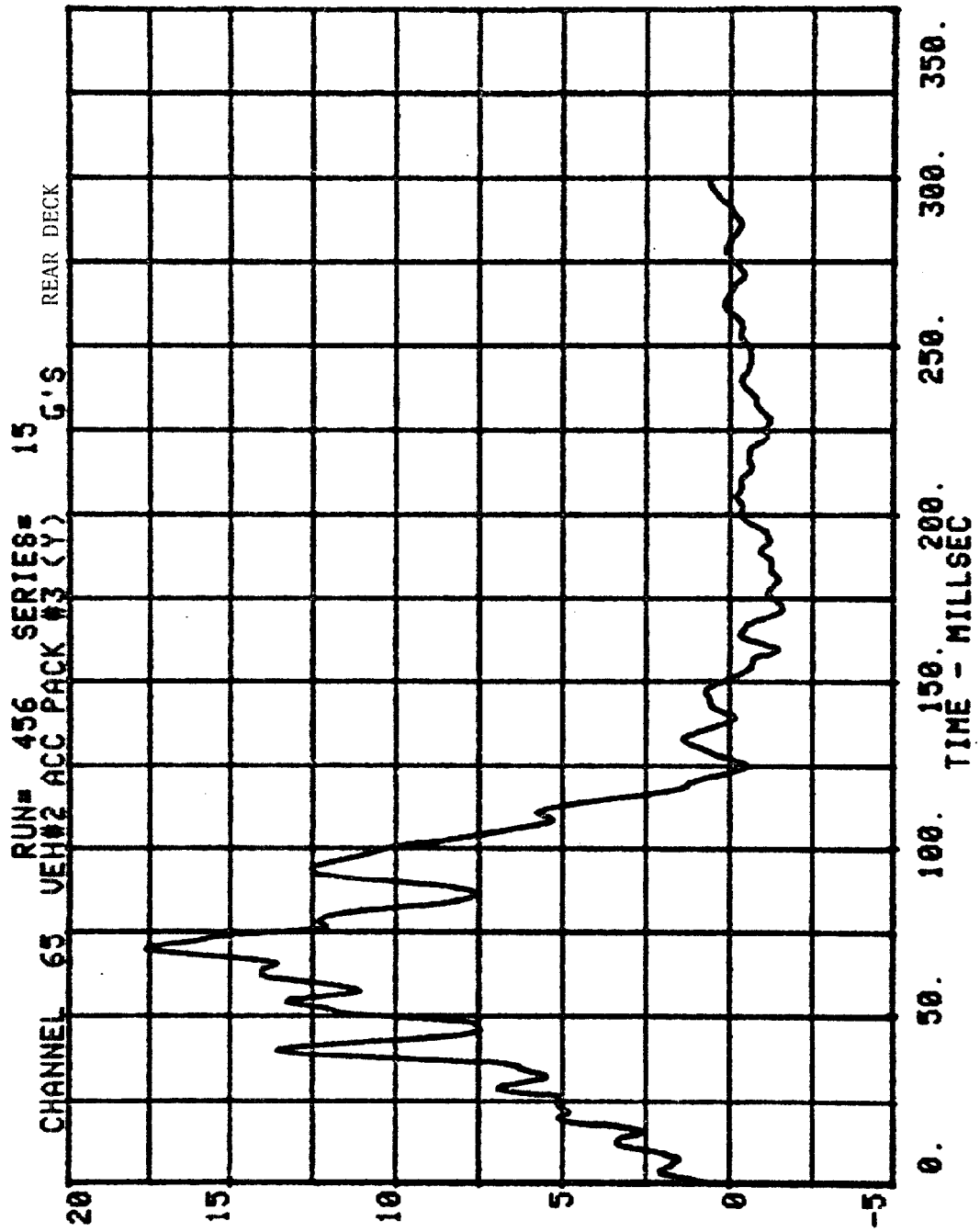

CHANNEL 31 DISPLACEMENT
RUN= 456 SERIES= 15
VEH #2 PACK #2 Y INCHES
RIGHT REAR COMPARTMENT
80
60
40
20
0
-20
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

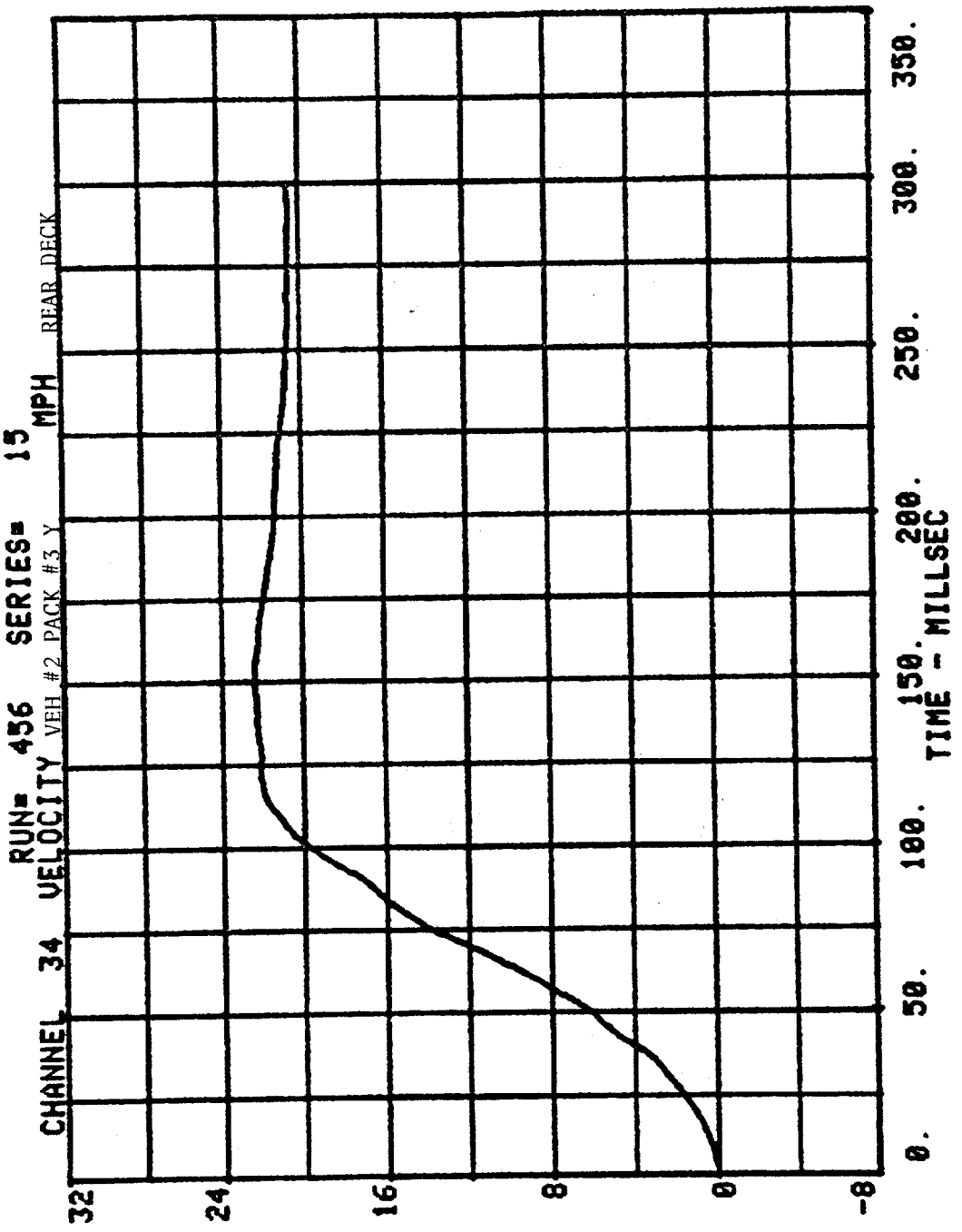

CHANNEL 63 RUN= 456 SERIES= 15
VEH#2 ACC PACK #2 (Z) G'S
RIGHT REAR COMPARTMENT
8
4
0
-4
-8
-12
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

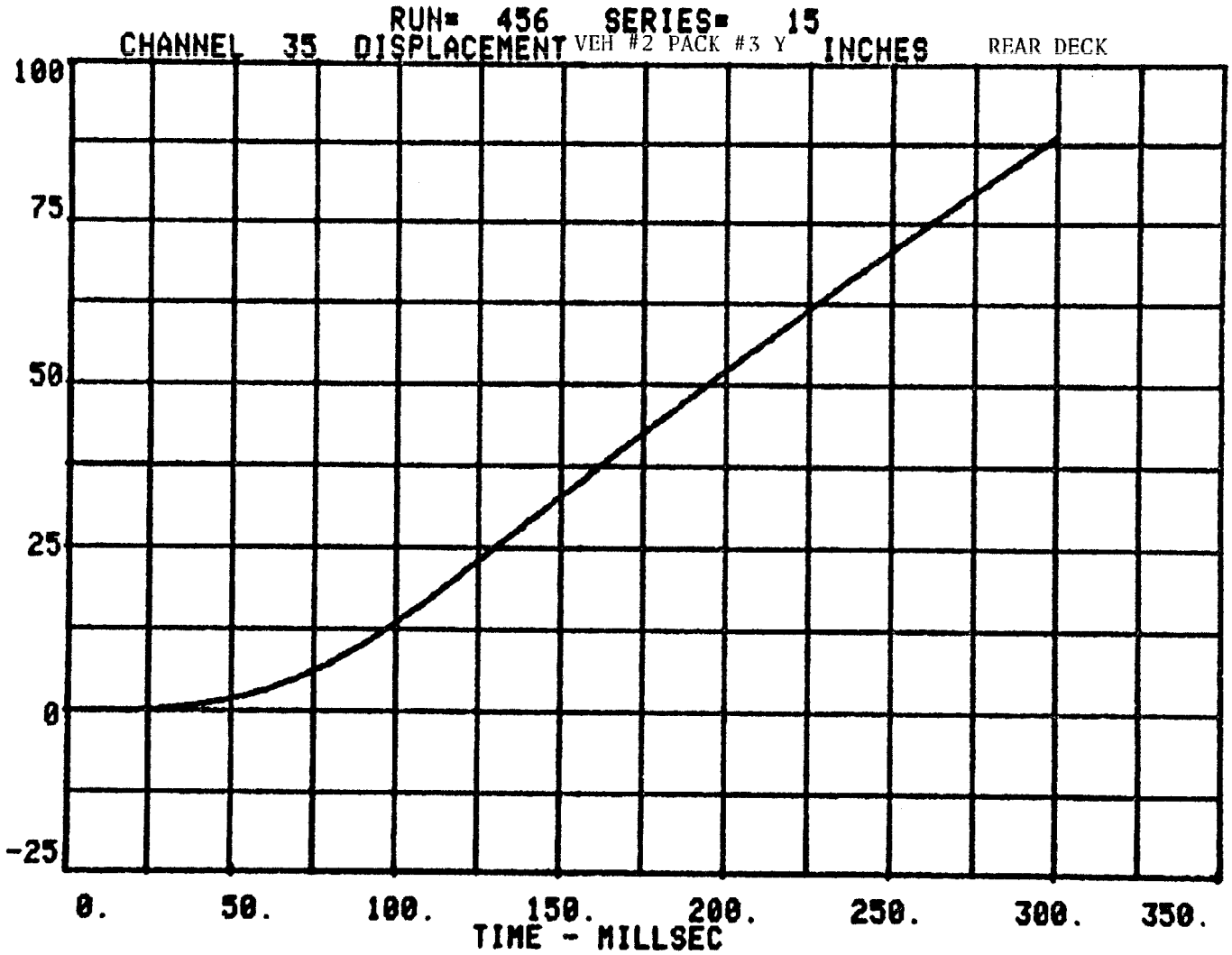

CHANNEL 64
RUN= 456 SERIES= 15
VEH#2 ACC PACK #3 (X)
G'S
REAR DECK
7.5
5.0
2.5
0.0
-2.5
-5.0
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

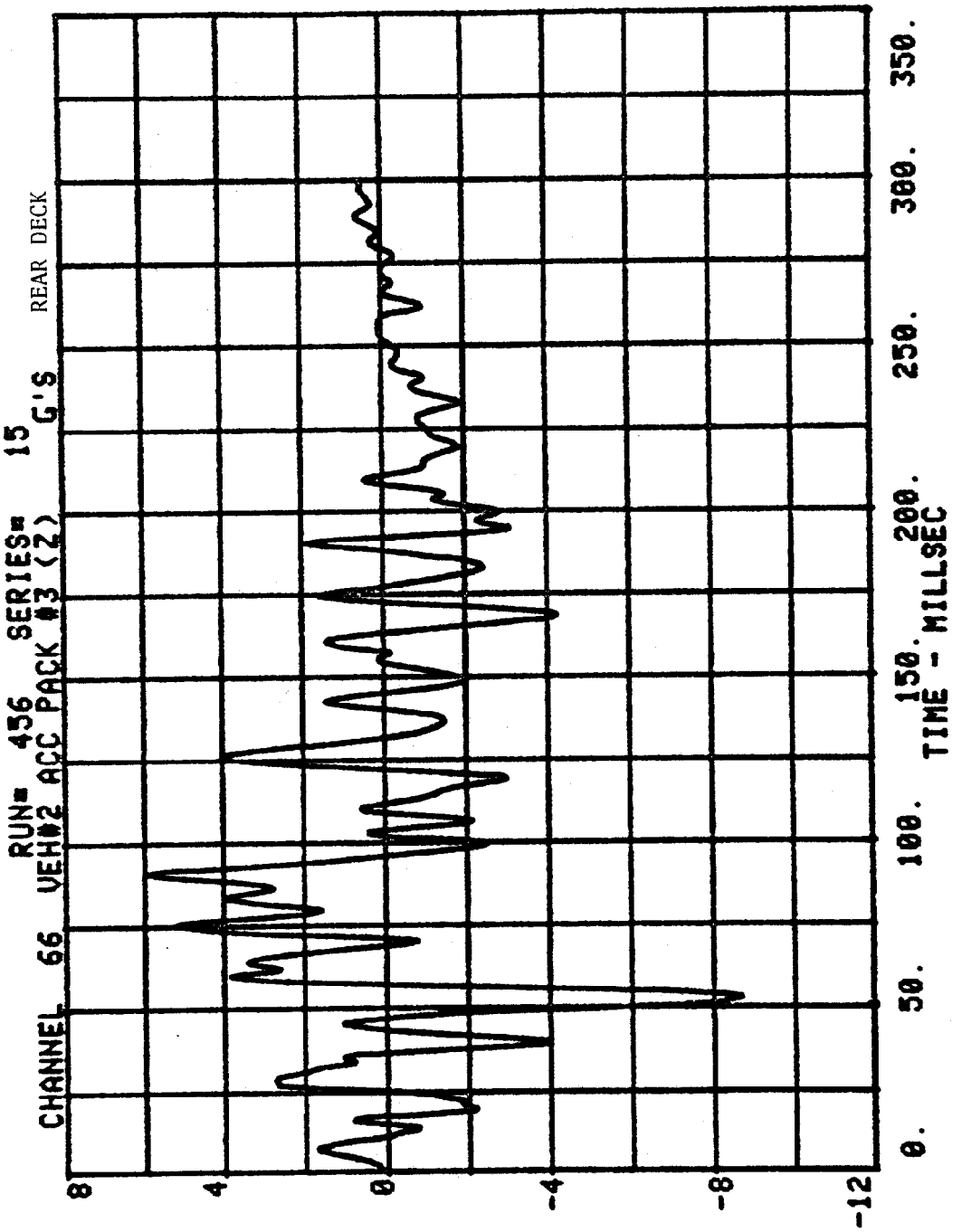

CHANNEL 32 VELOCITY VEH #2 PACK #3 X
RUN= 456 SERIES= 15 MPH REAR DECK
8
6
4
2
0
-2
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

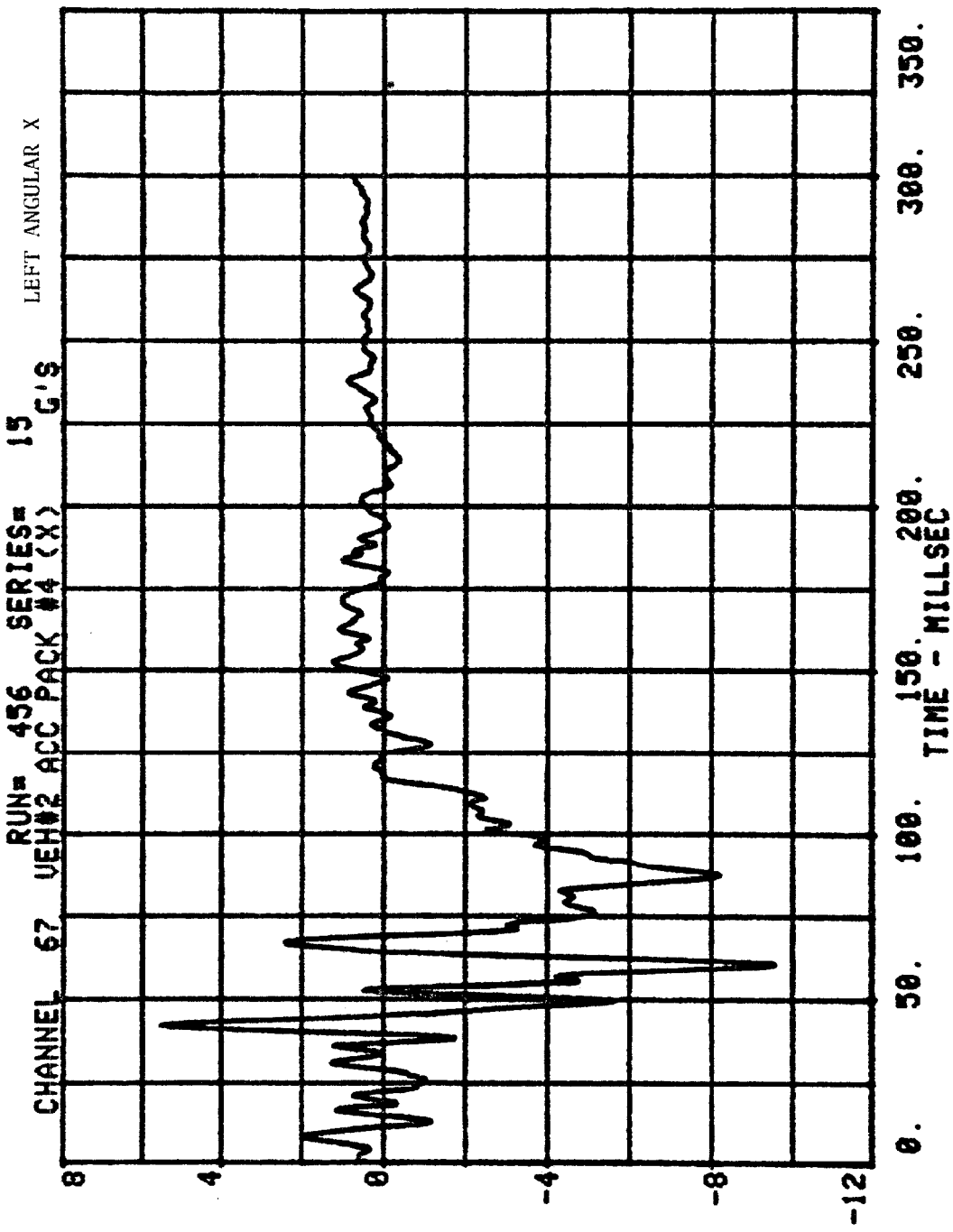

CHANNEL 33 DISPLACEMENT
RUN= 456 SERIES= 15
VEH #2 PACK 3 X INCHES
REAR DECK
32
24
16
8
0
-8
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

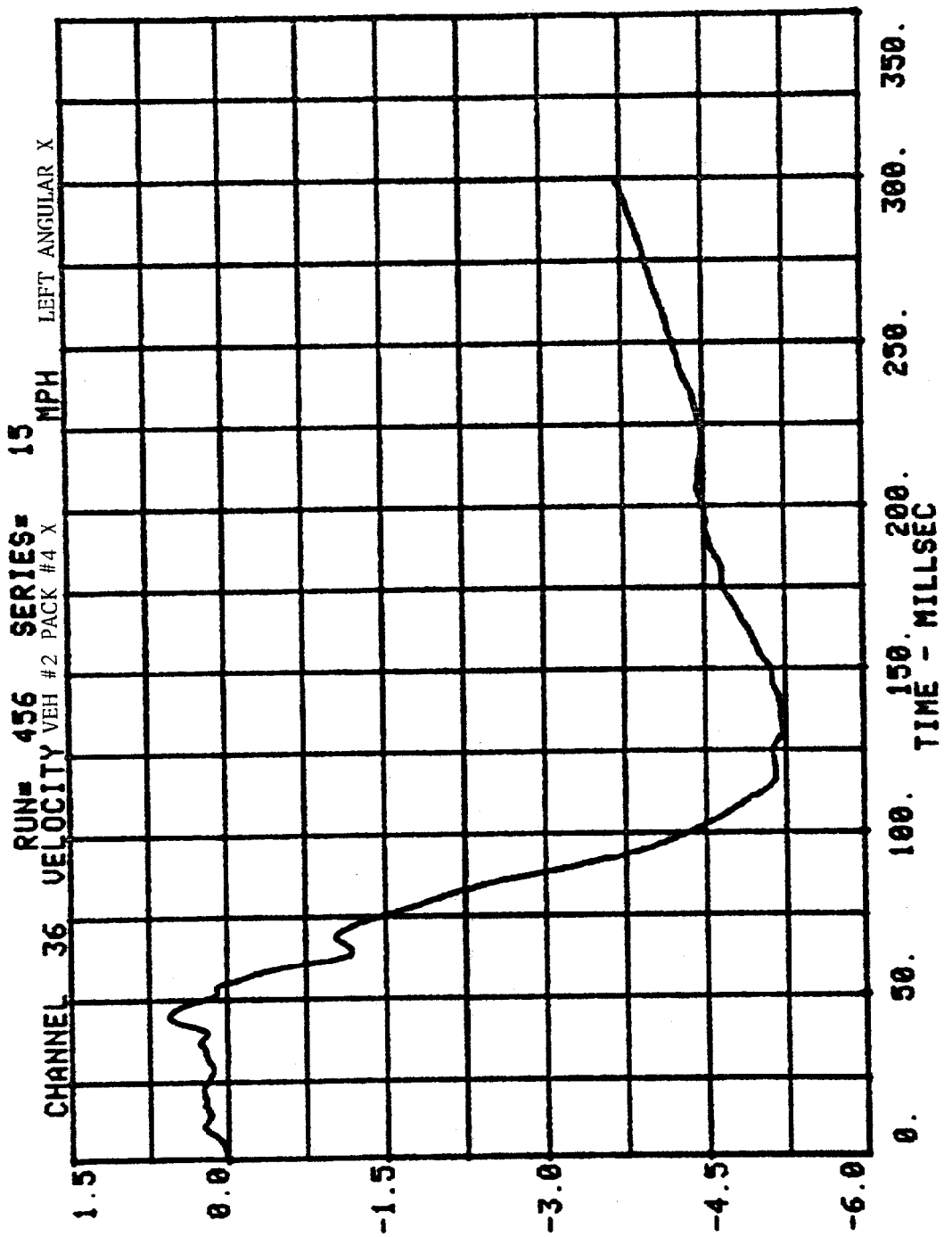

CHANNEL 65 VEH#2 ACC PACK #3 (Y)
RUN= 456 SERIES= 15
G'S
REAR DECK
20
15
10
5
0
-5
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

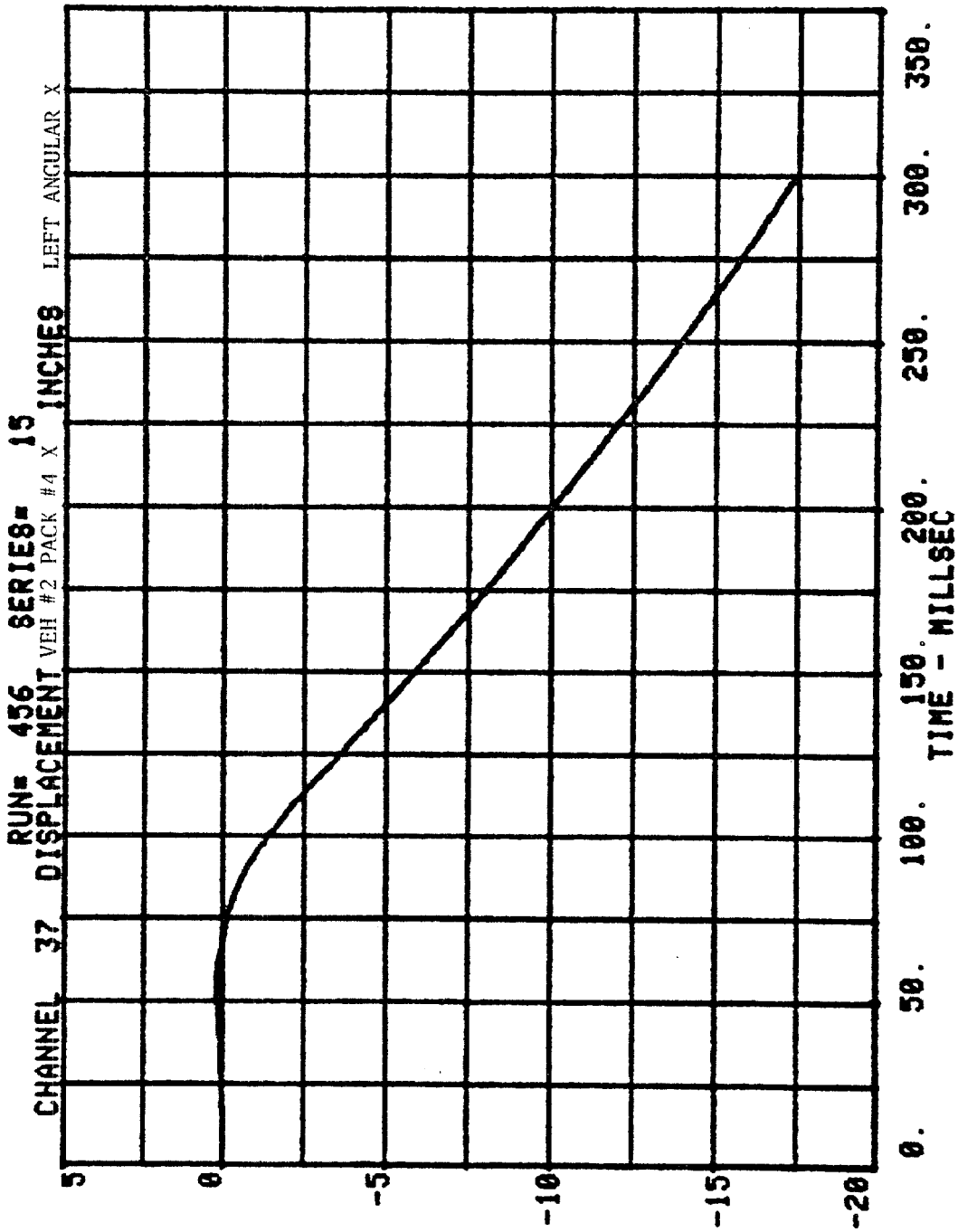

CHANNEL 34 VELOCITY RUN= 456 SERIES= 15 MPH REAR DECK
VEH #2 PACK #3 Y
32
24
16
8
0
-8
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

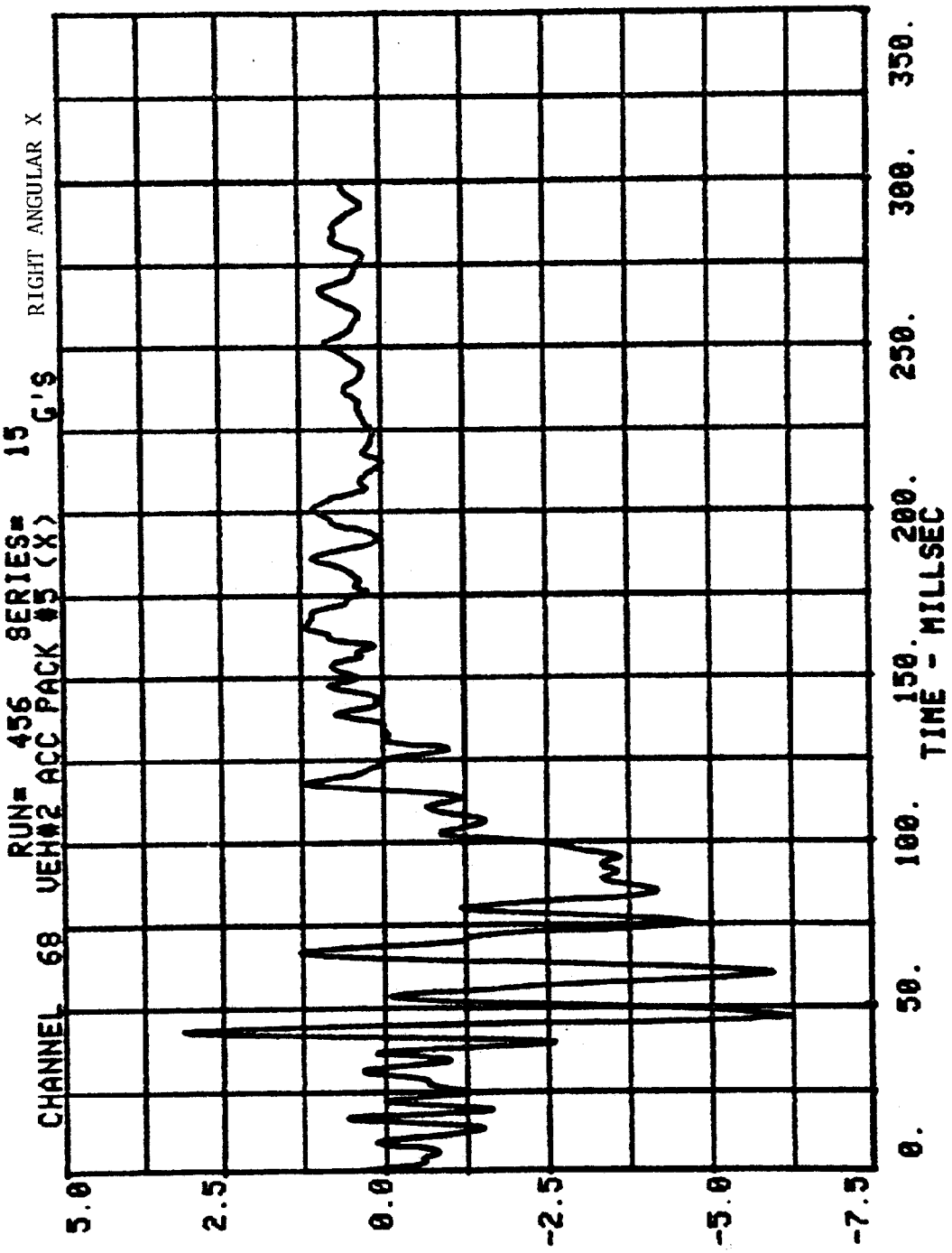

RUN= 456 SERIES= 15
CHANNEL 35 DISPLACEMENT VEH #2 PACK #3 Y INCHES REAR DECK
100
75
50
25
0
-25
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

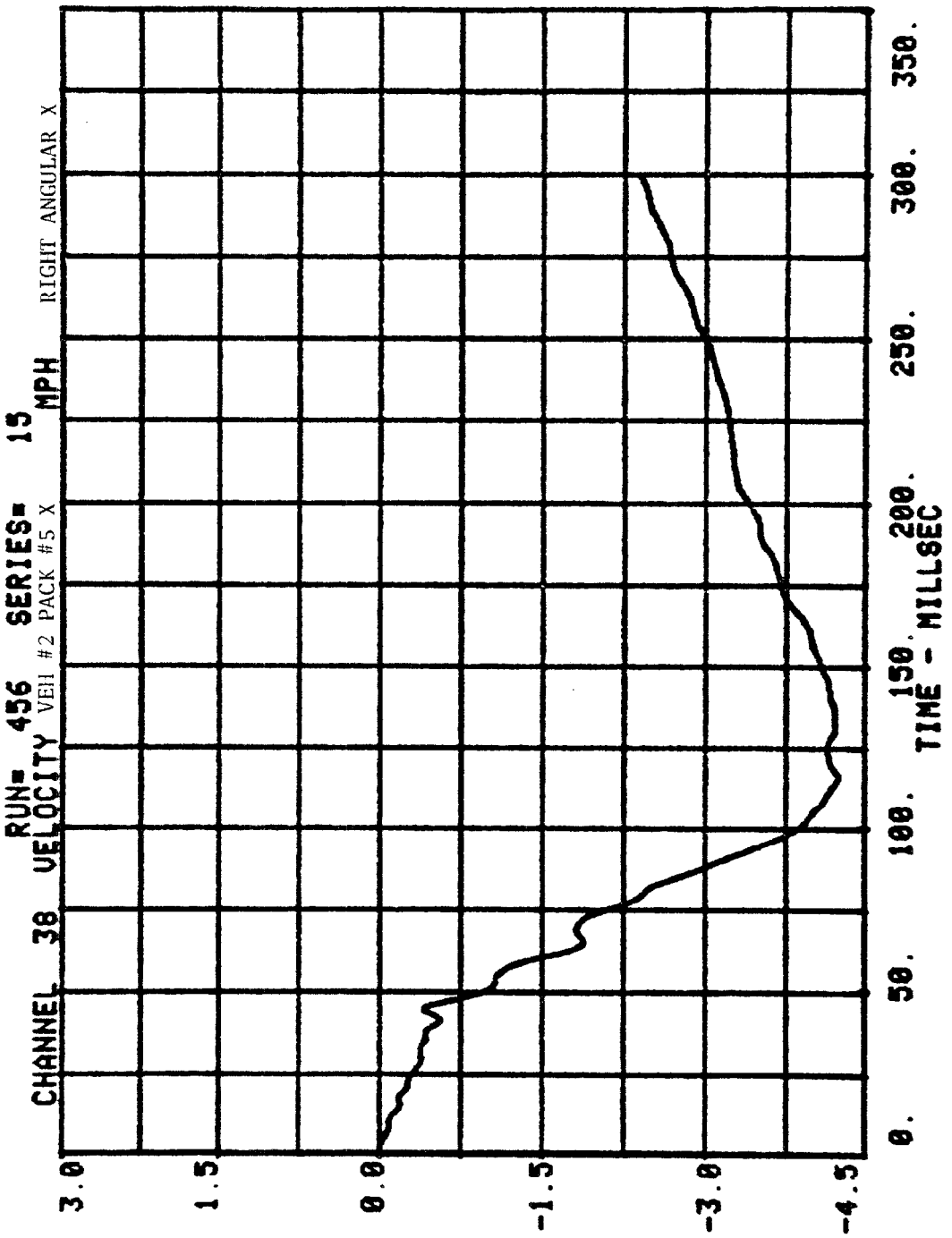

CHANNEL 66 VEH#2 ACC PACK #3 (2)
RUN= 456 SERIES= 15
G'S
REAR DECK
8
4
0
-4
-8
-12
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

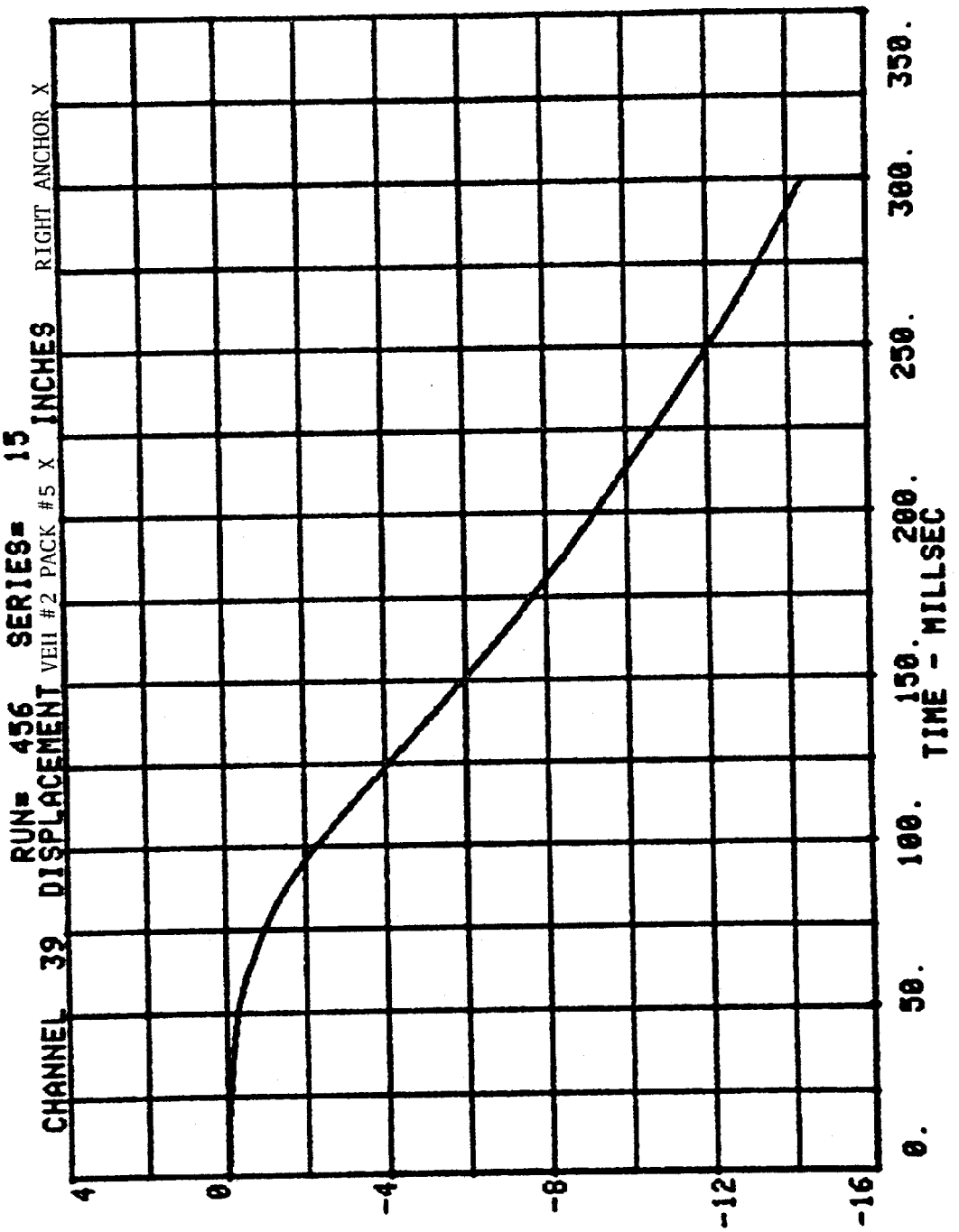

LEFT ANGULAR X
CHANNEL 67 VEH#2 ACC PACK #4 (X)
RUN= 456 SERIES= 15 G'S
8
4
0
-4
-8
-12
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

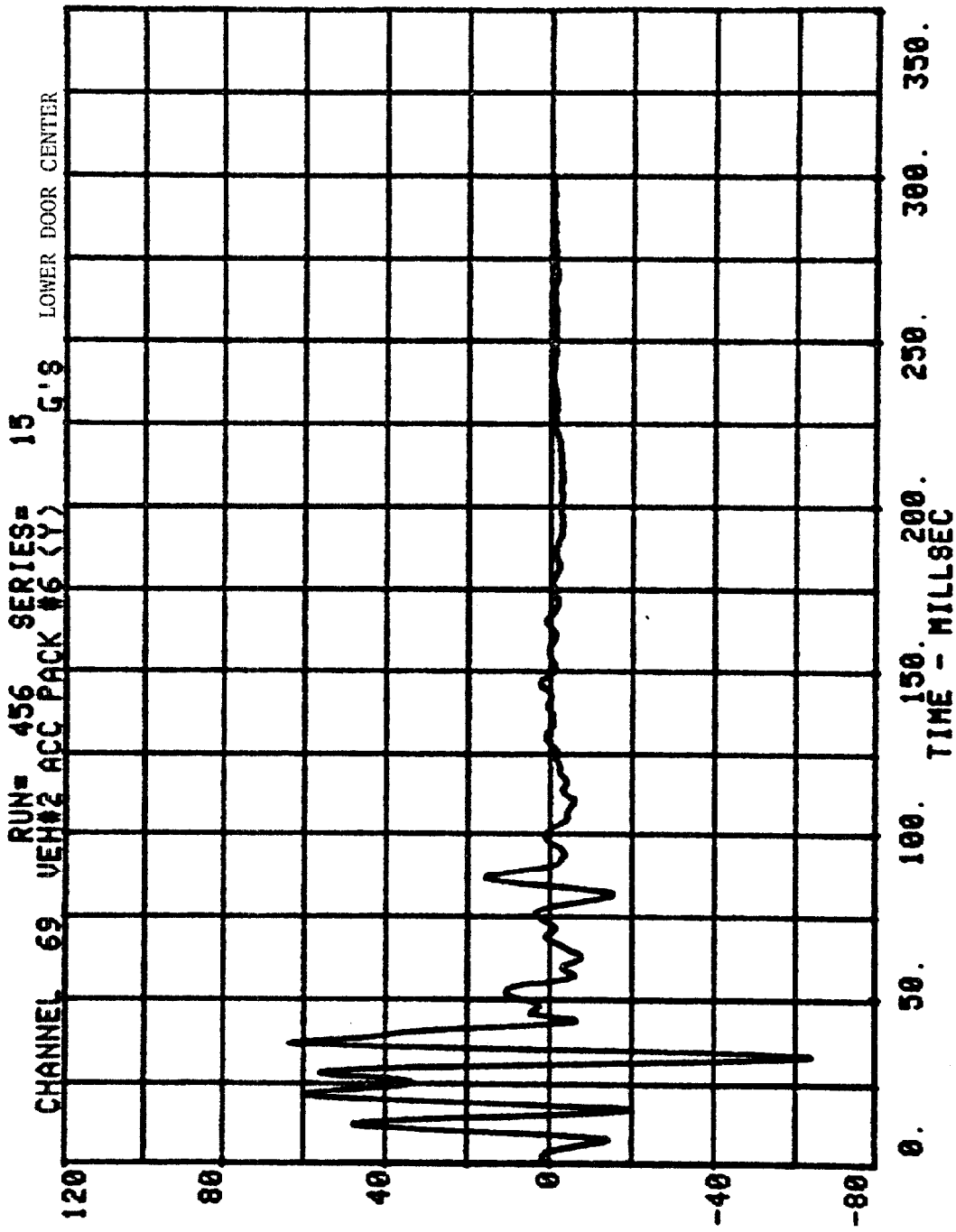

CHANNEL 36 VELOCITY VEH #2 PACK #4 X
RUN= 456 SERIES= 15 MPH
LEFT ANGULAR X
1.5
0.0
-1.5
-3.0
-4.5
-6.0
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

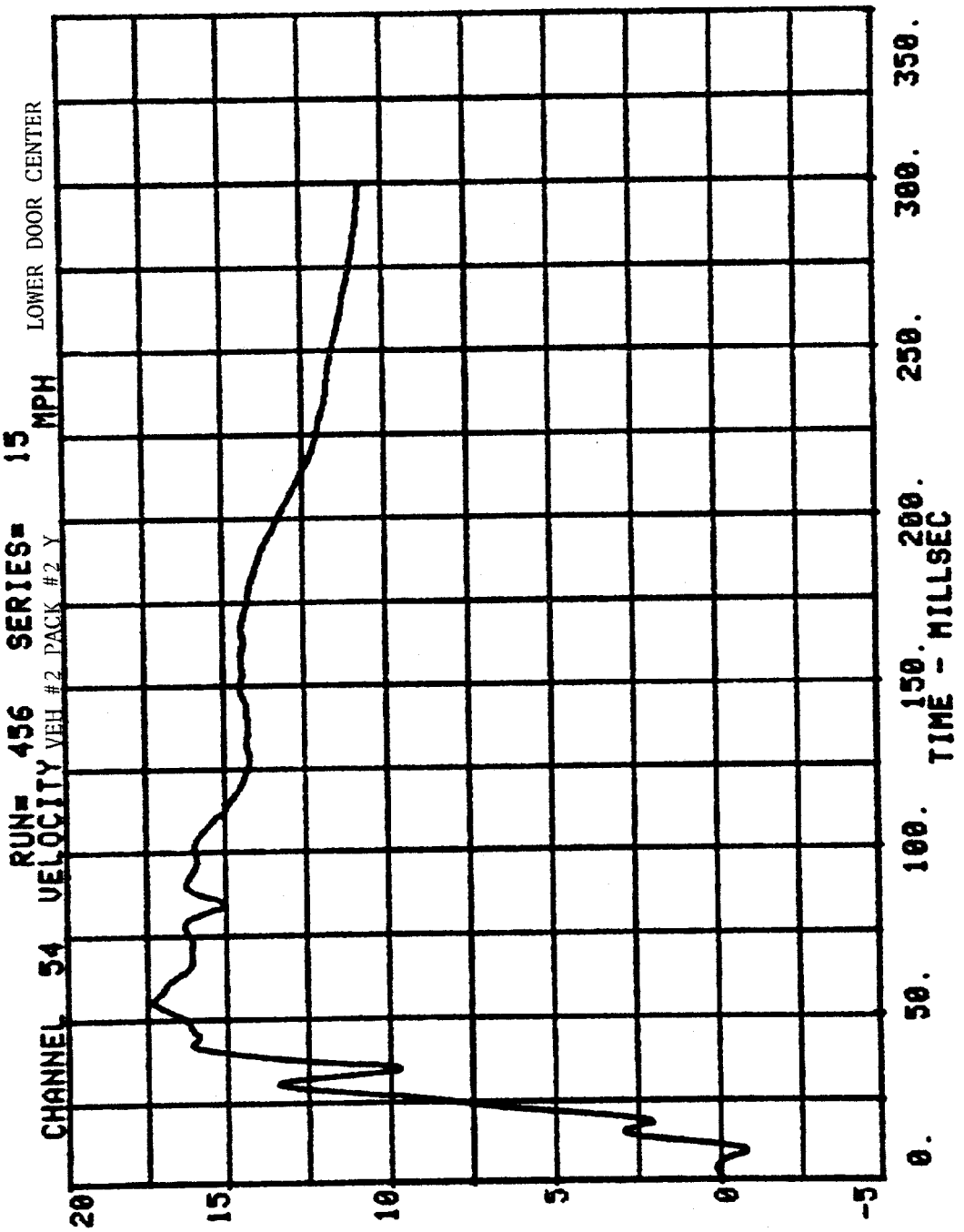

CHANNEL 37 DISPLACEMENT VEH #2 PACK #4 X INCHES LEFT ANGULAR X
RUN= 456 SERIES= 15
5
0
-5
-10
-15
-20
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

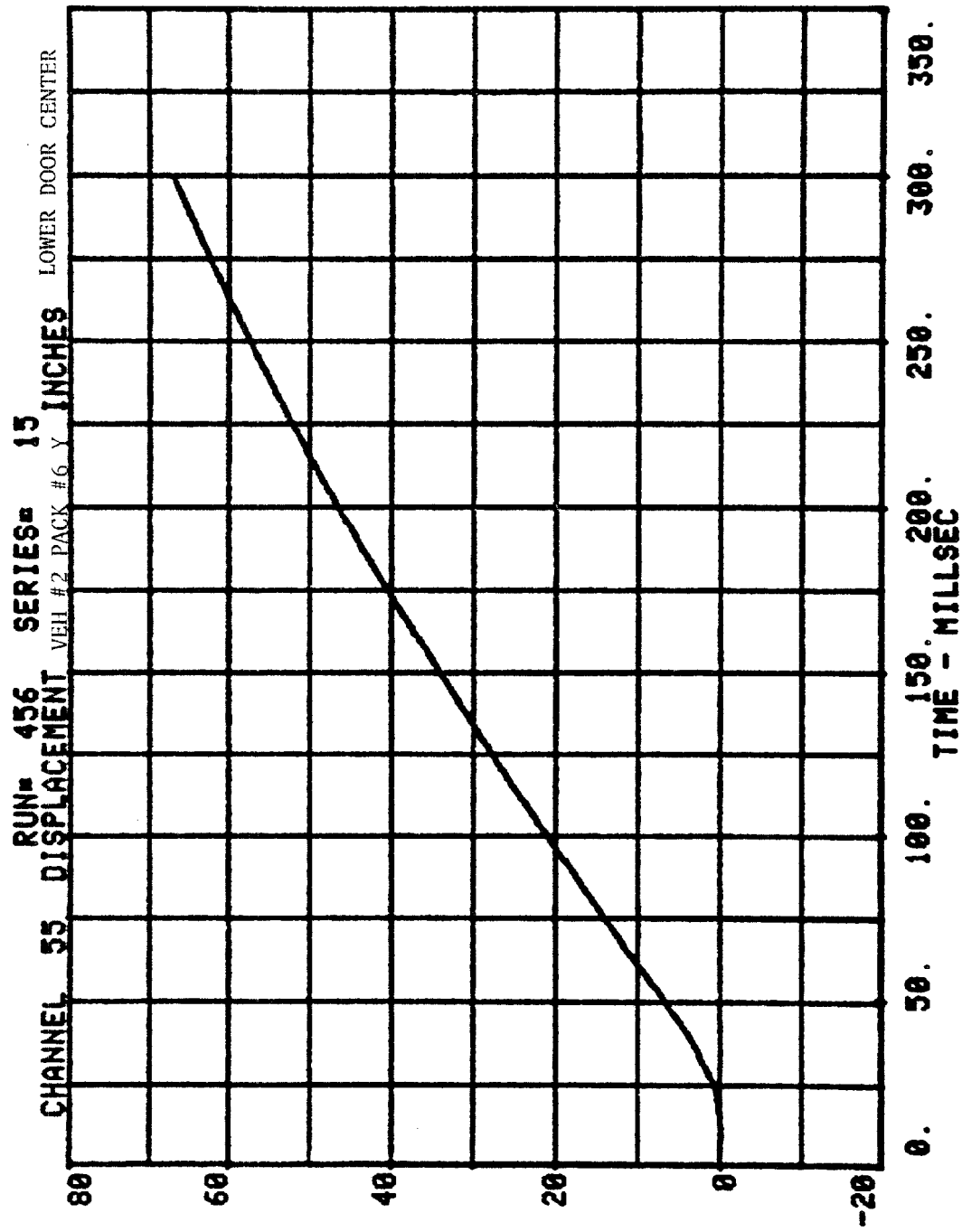

CHANNEL 68 RIGHT ANGULAR X
RUN= 456 SERIES= 15
VEH#2 ACC PACK #5 (X) G'S
5.0
2.5
0.0
-2.5
-5.0
-7.5
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

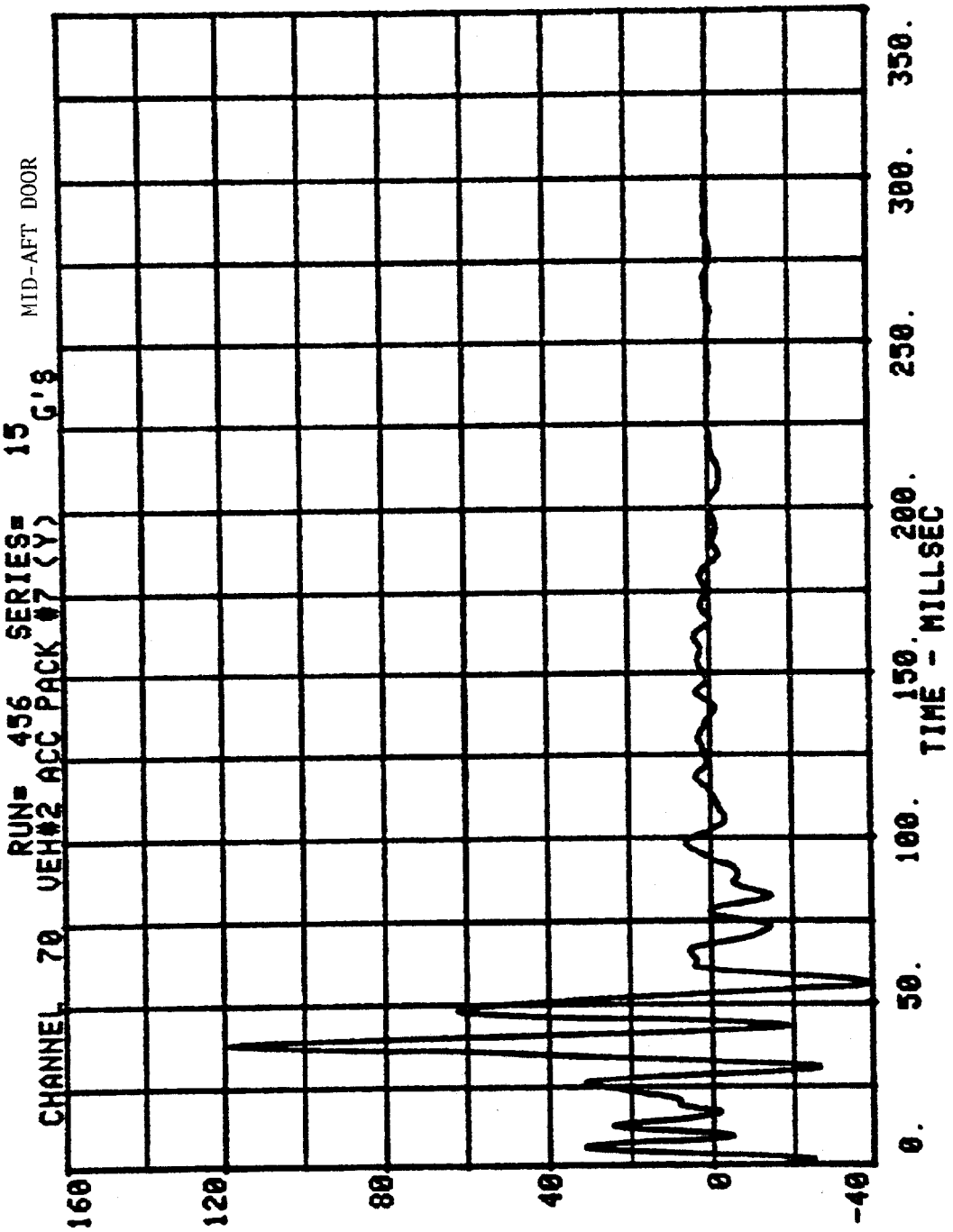

CHANNEL 38 RUN= 456 SERIES= 15
VELOCITY VEH #2 PACK #5 X MPH
RIGHT ANGULAR X
3.0
1.5
0.0
-1.5
-3.0
-4.5
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

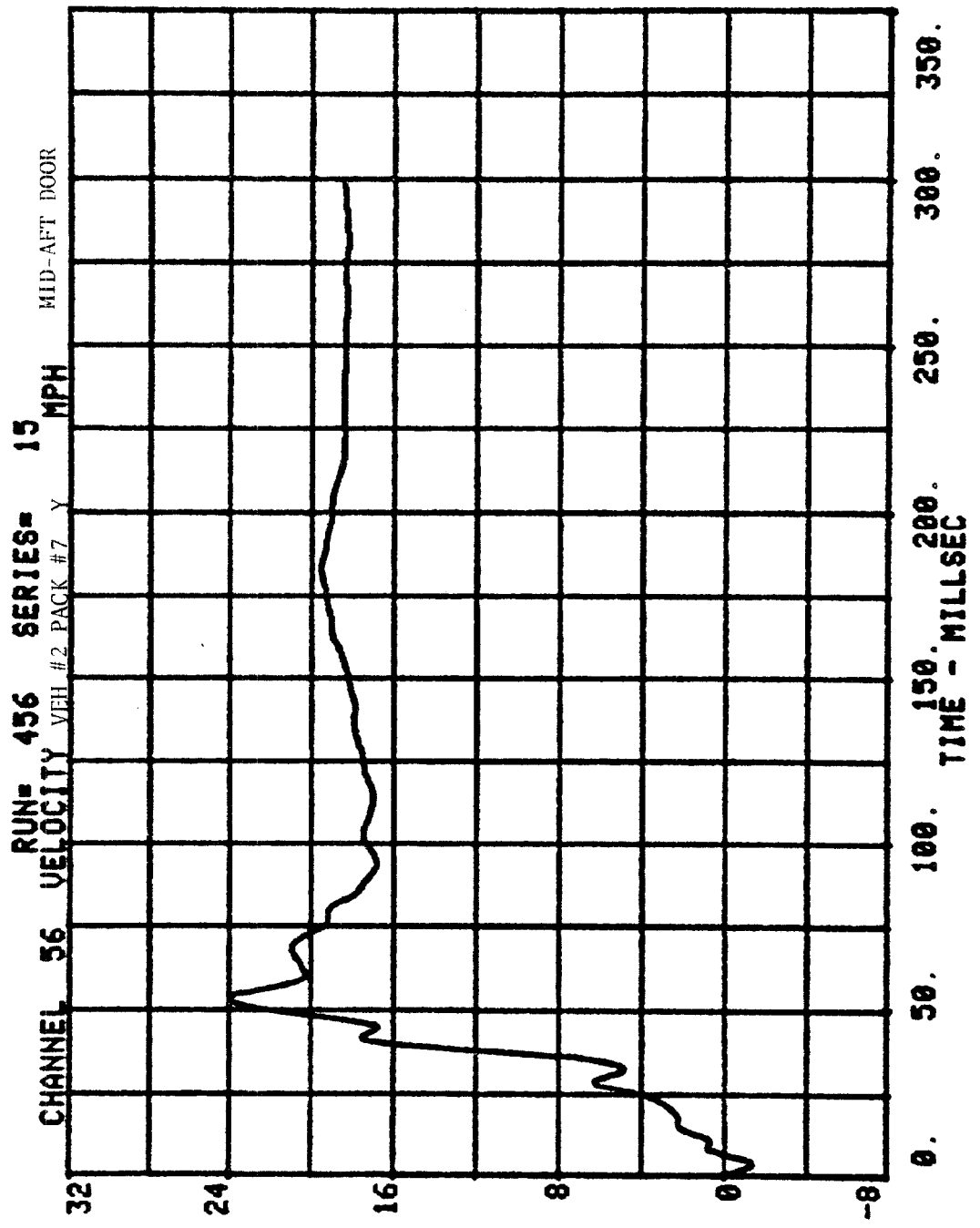

CHANNEL 39 DISPLACEMENT
RUN= 456 SERIES= 15
VEH #2 PACK #5 X INCHES
RIGHT ANCHOR X
4
0
-4
-8
-12
-16
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

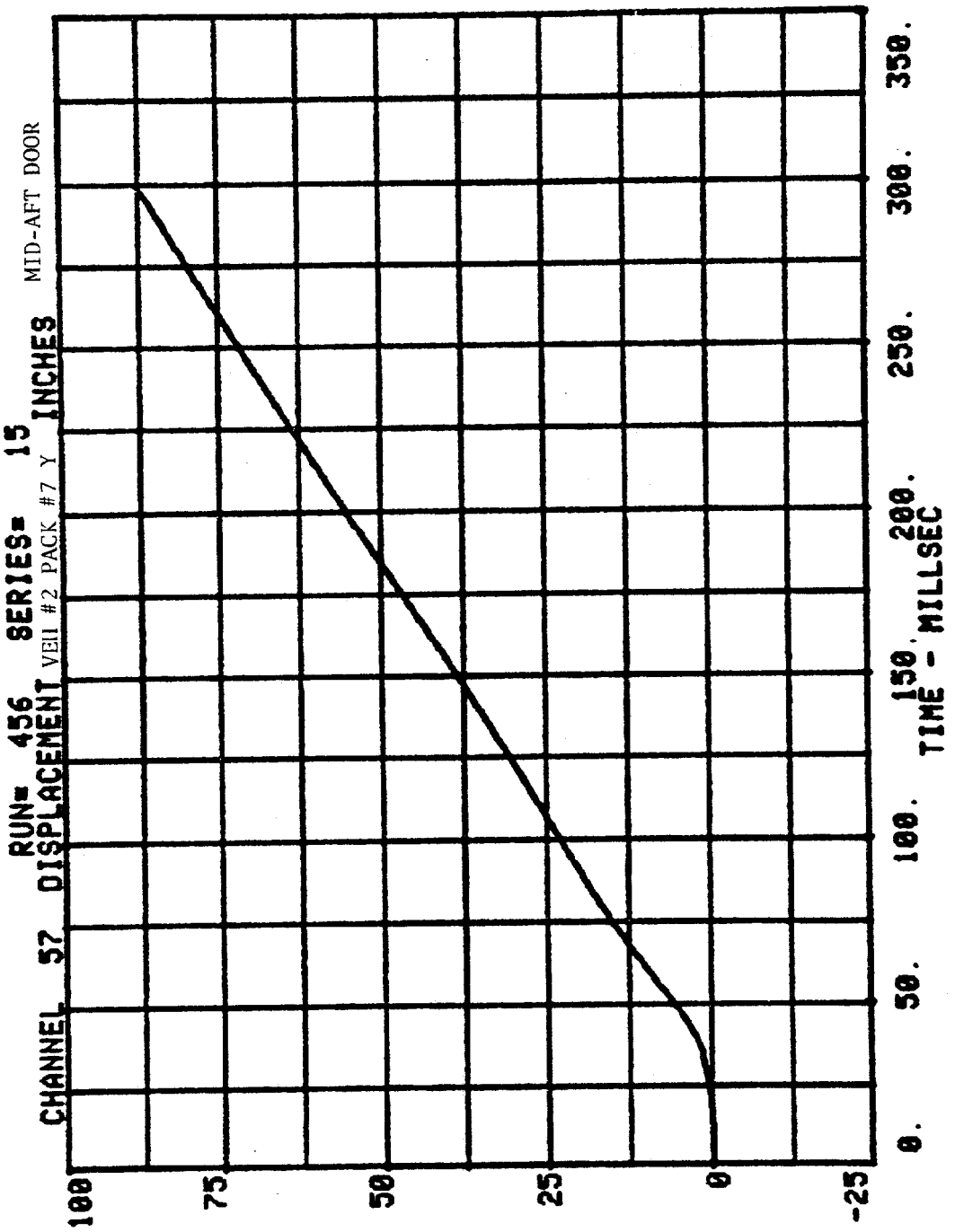

CHANNEL 69 VEH#2 ACC PACK #6 (Y)
RUN= 456 SERIES= 15
G'S
LOWER DOOR CENTER
120
80
40
0
-40
-80
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

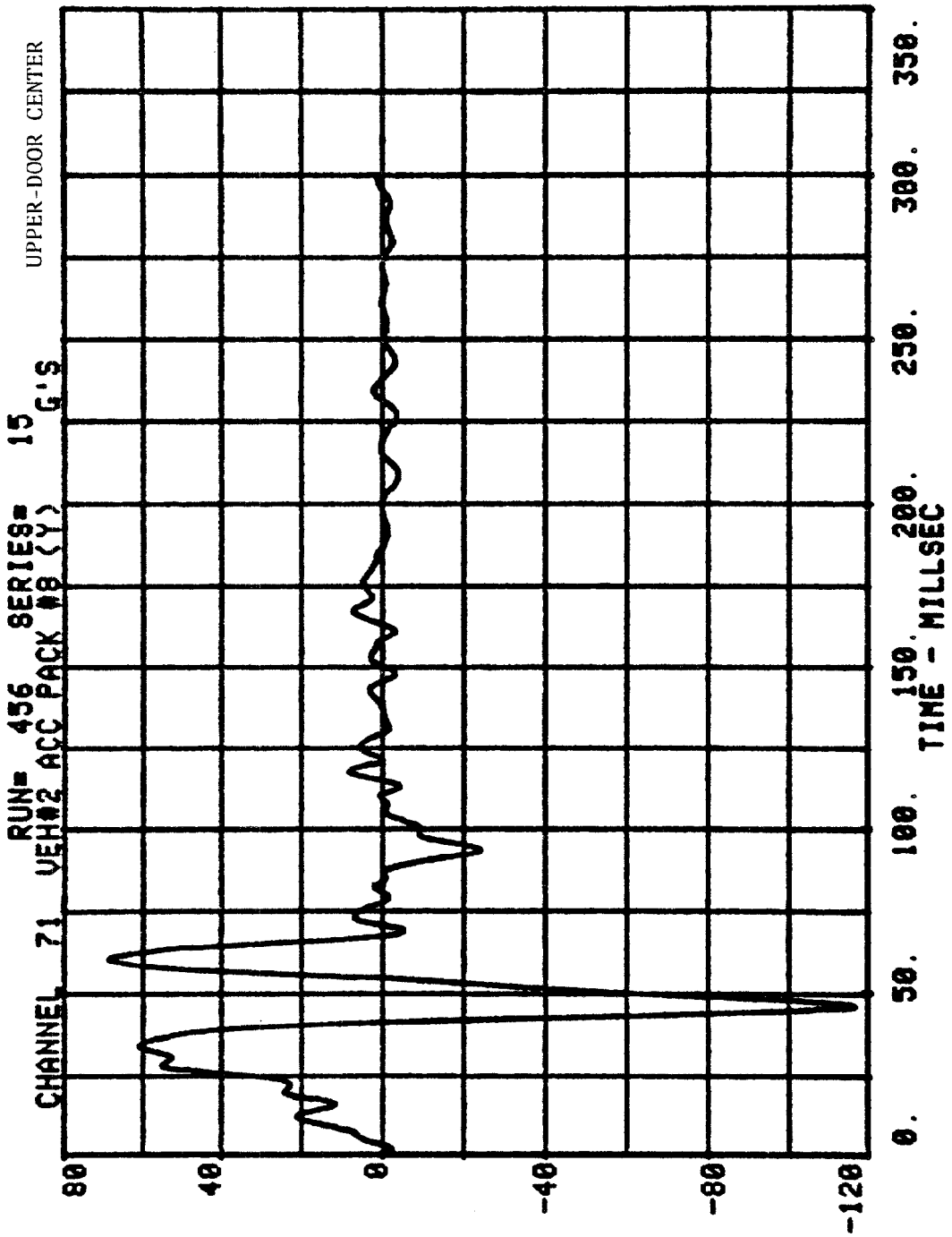

CHANNEL 54 RUN= 436 SERIES= 15
VELOCITY VEH #2 PACK #2 Y MPH
LOWER DOOR CENTER
20
15
10
5
0
-5
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

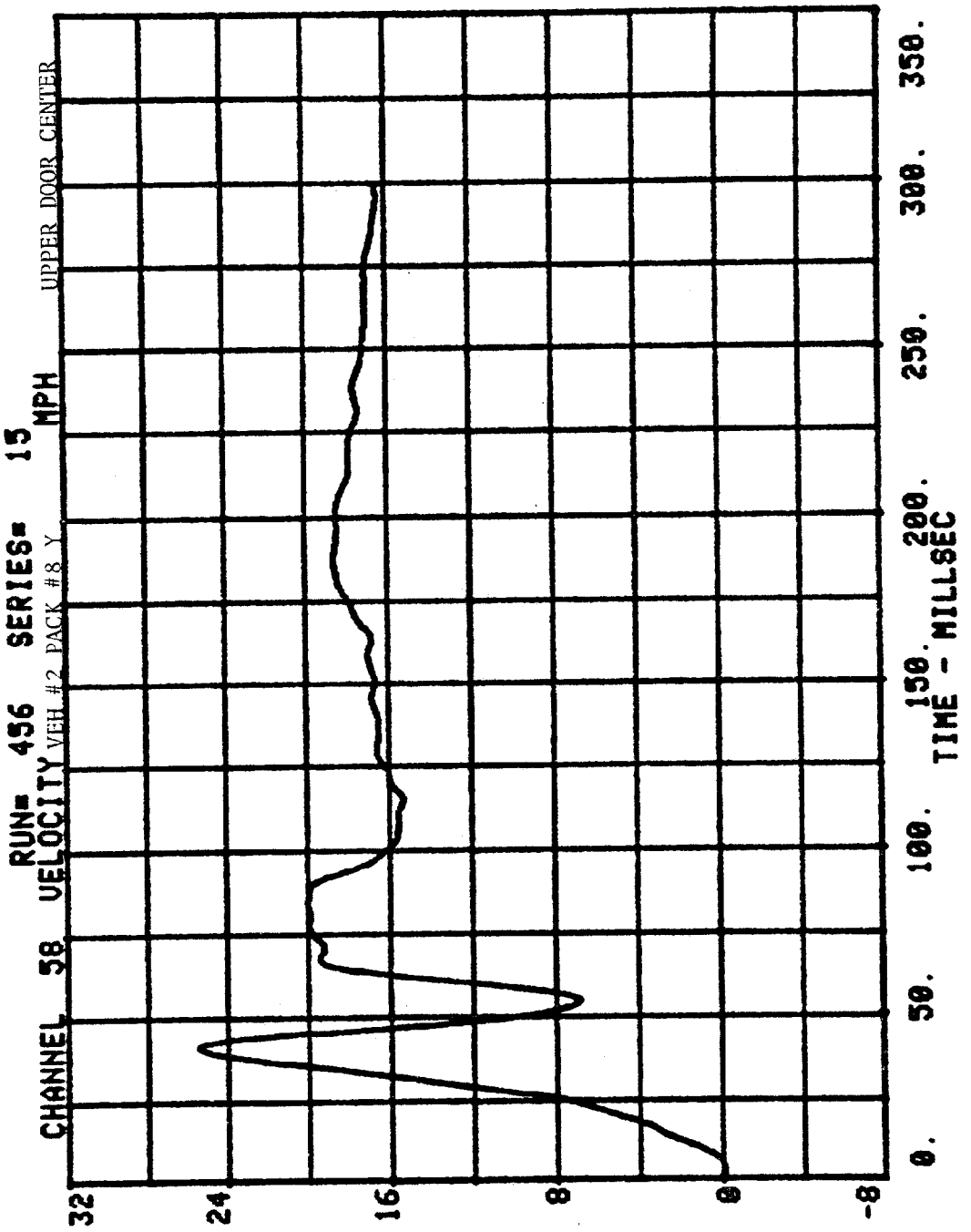

CHANNEL 55 DISPLACEMENT RUN= 456 SERIES= 15
VEH #2 PACK #6 Y INCHES LOWER DOOR CENTER
80
60
40
20
0
-20
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

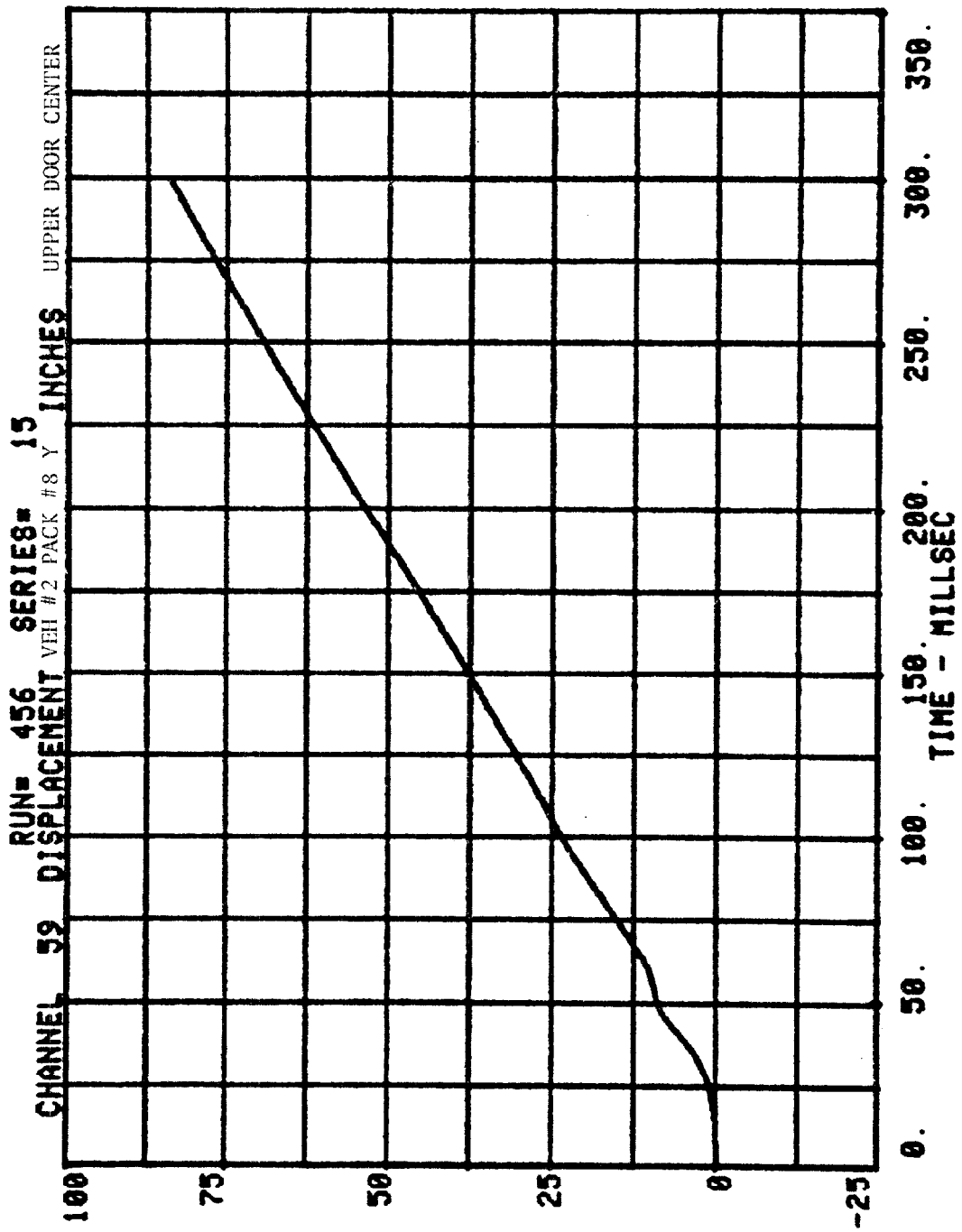

CHANNEL 70 VEH#2 ACC PACK #7 (Y)
RUN= 456 SERIES= 15 G'S
MID-AFT DOOR
160
120
80
40
0
-40
0.
50.
100.
150.
200.
230.
300.
350.
TIME - MILLSEC

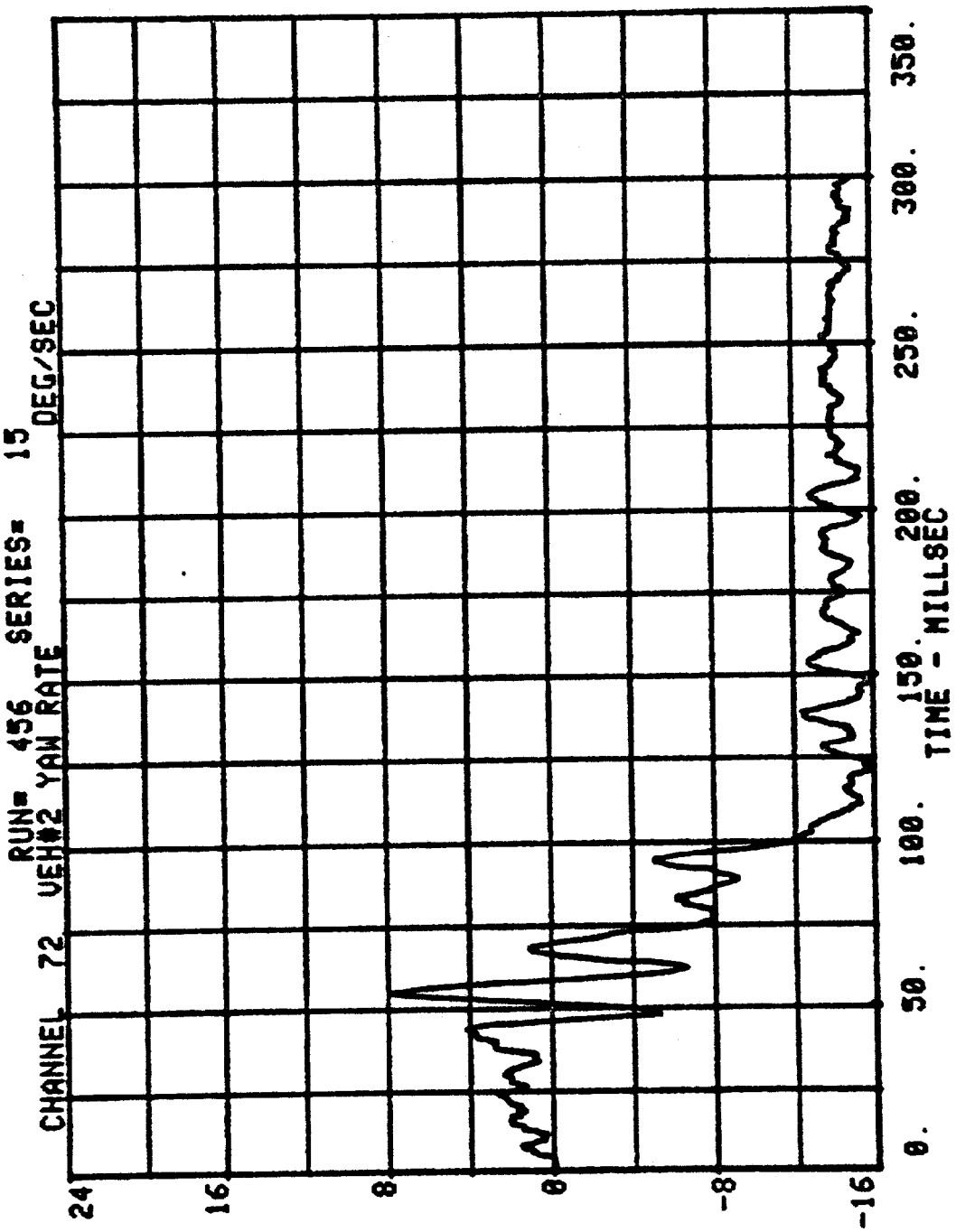

CHANNEL 56 VELOCITY RUN= 456 SERIES= 15 MPH
VEH #2 PACK #7 Y
MID-AFT DOOR
32
24
16
8
0
-8
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

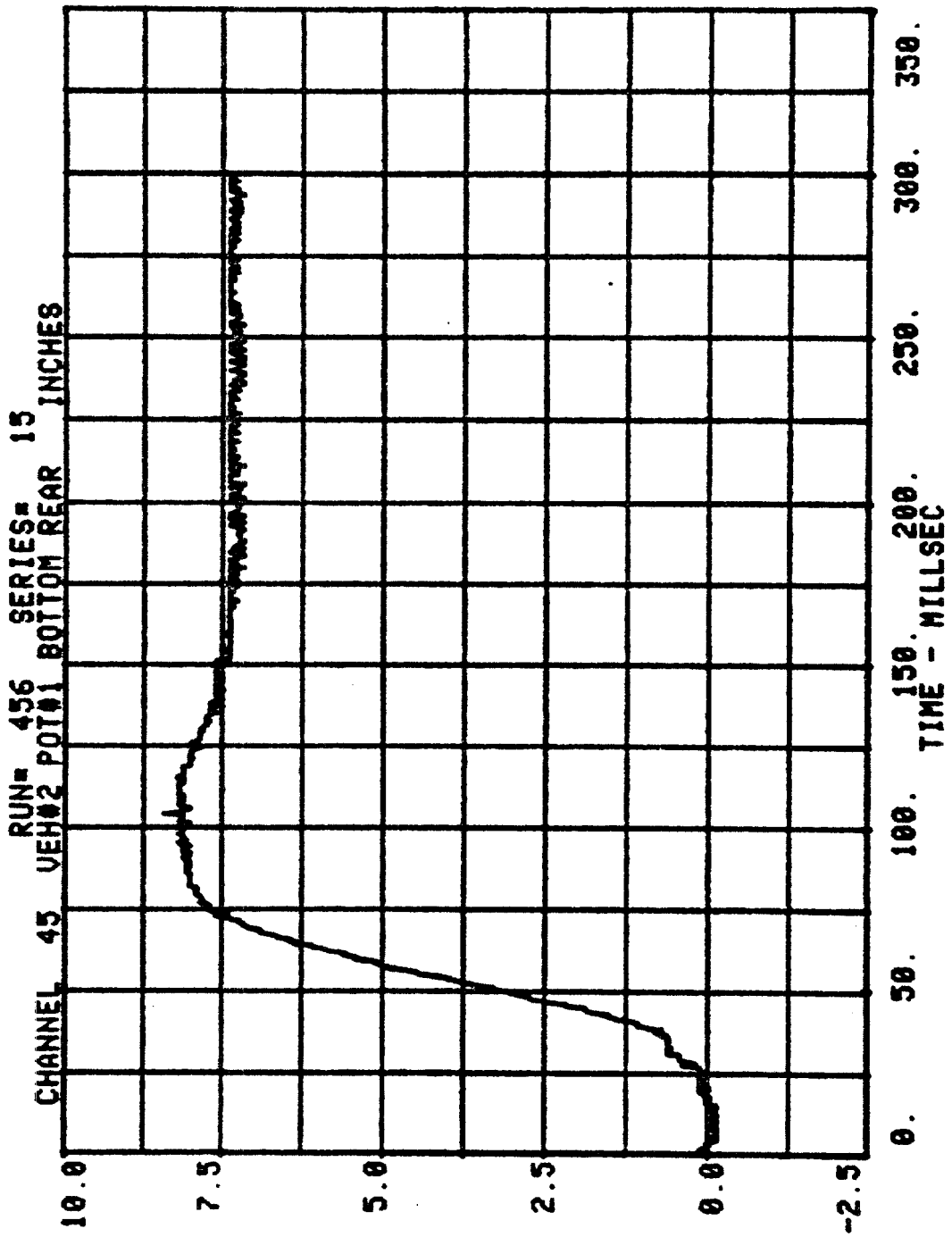

CHANNEL 57 DISPLACEMENT
RUN= 456 SERIES= 15
VEH #2 PACK #7 Y INCHES
MID-AFT DOOR
100
75
50
25
0
-25
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

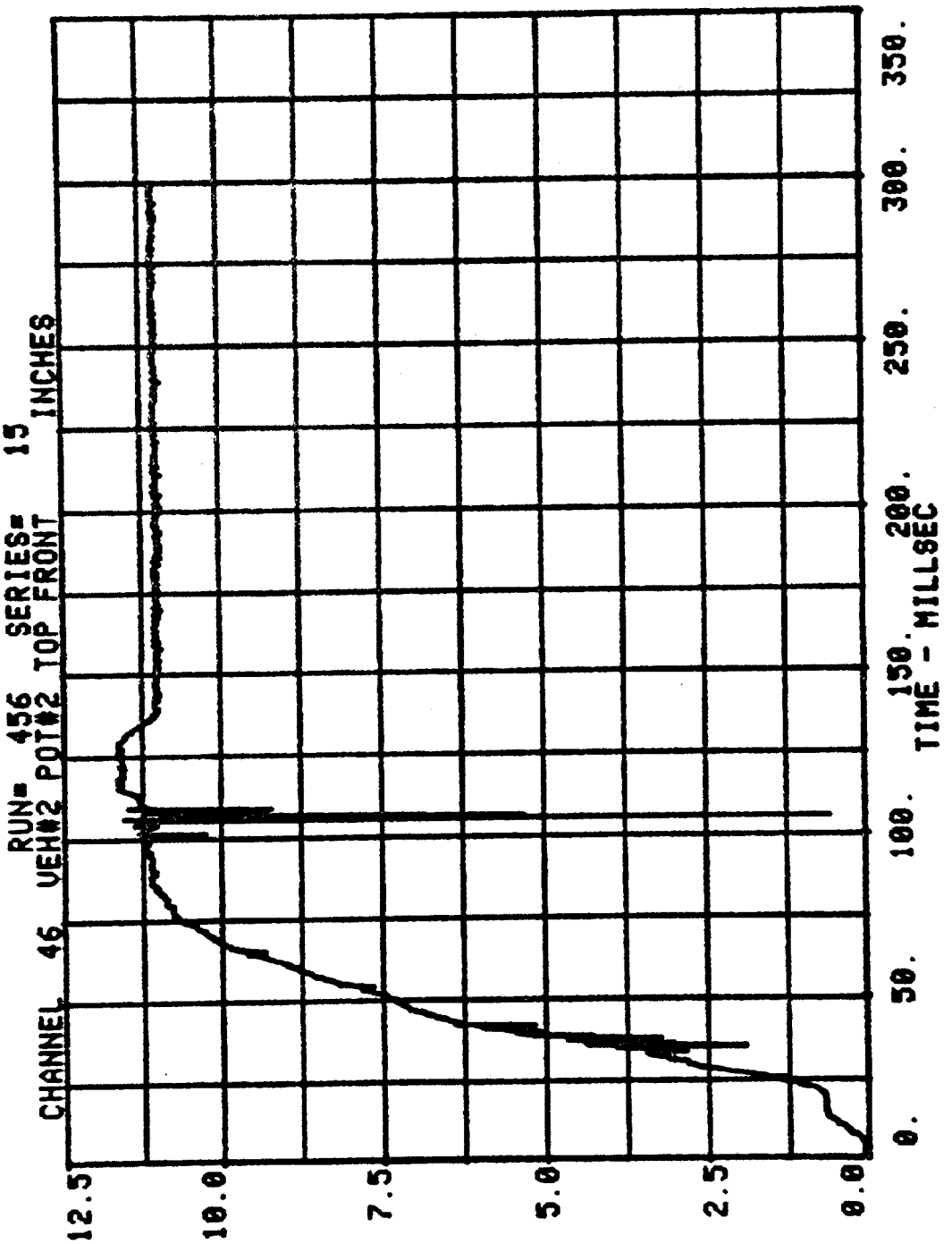

UPPER-DOOR CENTER
CHANNEL 71 RUN= 456 SERIES= 15
VEH#2 ACC PACK #8 (Y) G'S
80
40
0
-40
-80
-120
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

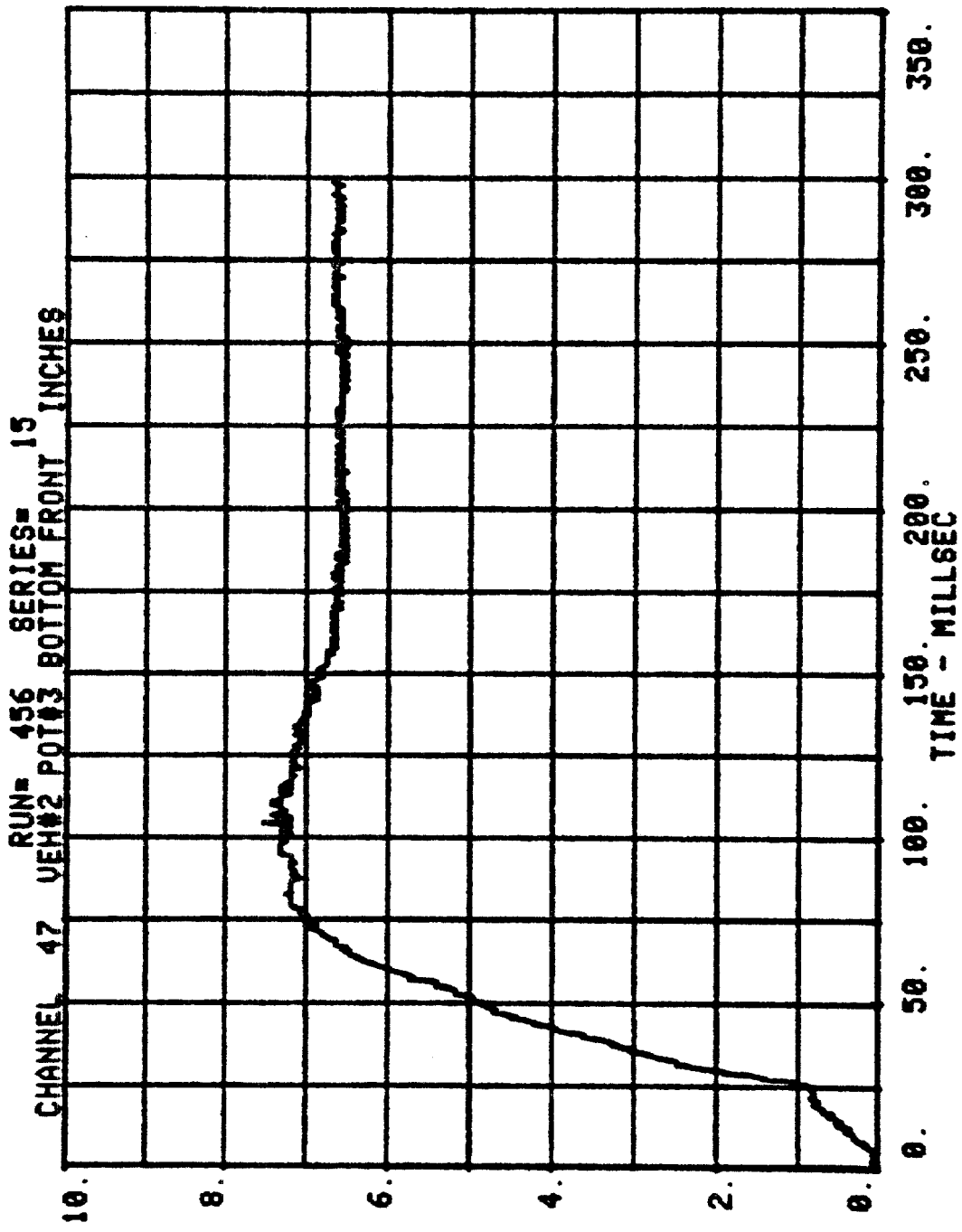

CHANNEL 58 RUN= 456 SERIES= 15
VELOCITY VEH #2 PACK #8 Y
MPH
UPPER DOOR CENTER
32
24
16
8
0
-8
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

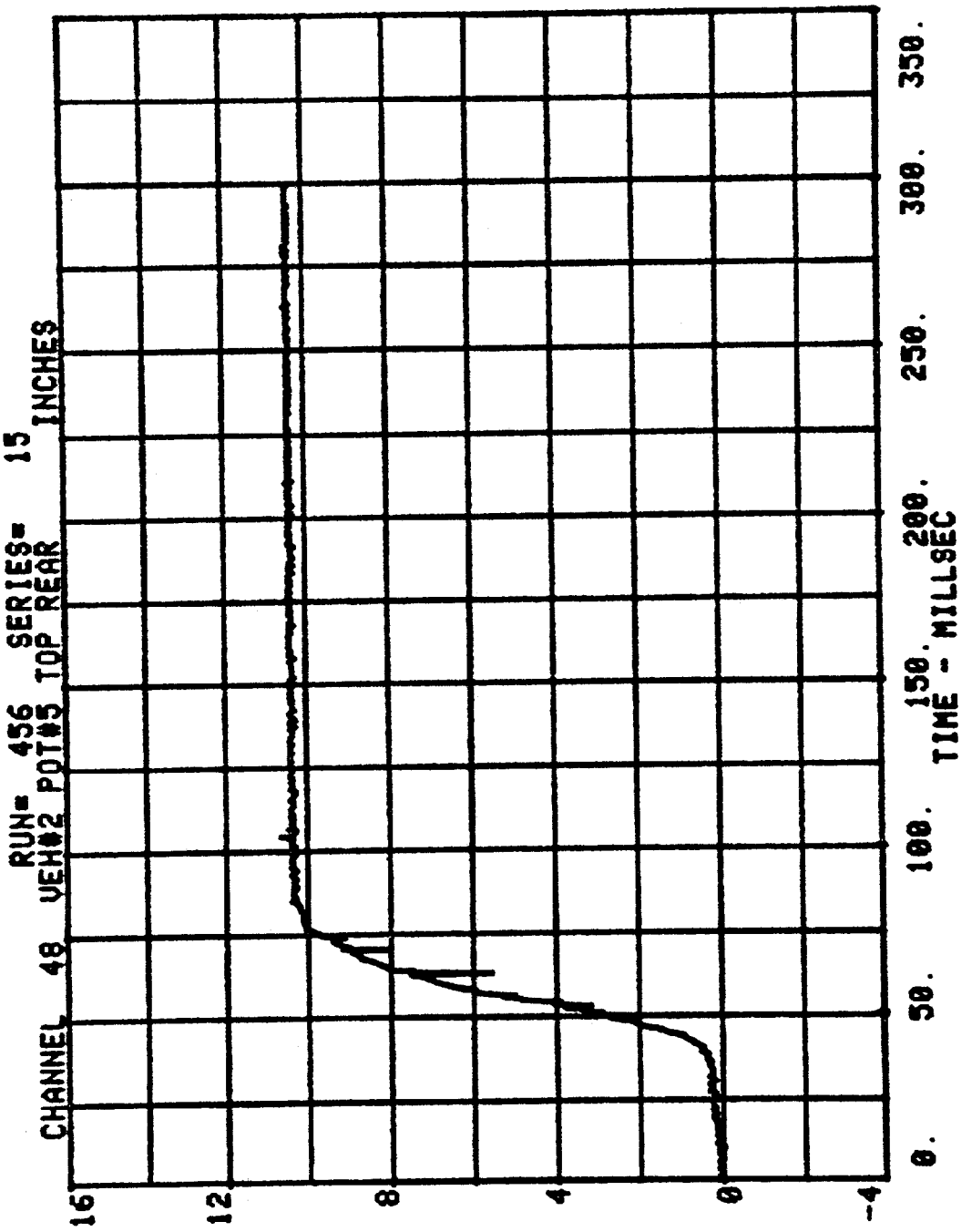

CHANNEL 59 DISPLACEMENT VEH #2 PACK #8 Y INCHES UPPER DOOR CENTER
RUN= 456 SERIES= 15
100
75
50
25
0
-25
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 72 VEH#2 YAW RATE
RUN= 456 SERIES= 15 DEG/SEC
24
16
8
0
-8
-16
0.
50.
100.
150.
200.
250.
300.
350.
TIME = MILLSEC


CHANNEL 45 RUN= 456 SERIES= 15
VEH#2 POT#1 BOTTOM REAR INCHES
10.0
7.5
5.0
2.5
0.0
-2.5
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 46 VEH#2 POT#2 RUN= 456 SERIES= 15
TOP FRONT
INCHES
12.5
10.0
7.5
5.0
2.5
0.0
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 47 RUN= 456 SERIES= 15
VEH#2 POT#3 BOTTOM FRONT INCHES
10.
8.
6.
4.
2.
0.
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 48 VEH#2 POT#5 TOP REAR
RUN= 456 SERIES= 15
INCHES
16
12
8
4
0
-4
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

TEST NO. 14

VEHICLE NO. 2 - DUMMY DATA

	Channel Filter Class
Head Accelerations	1000
Chest Accelerations	180

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

BUDD #15 SIDE IMPACT TEST

RUN= 456

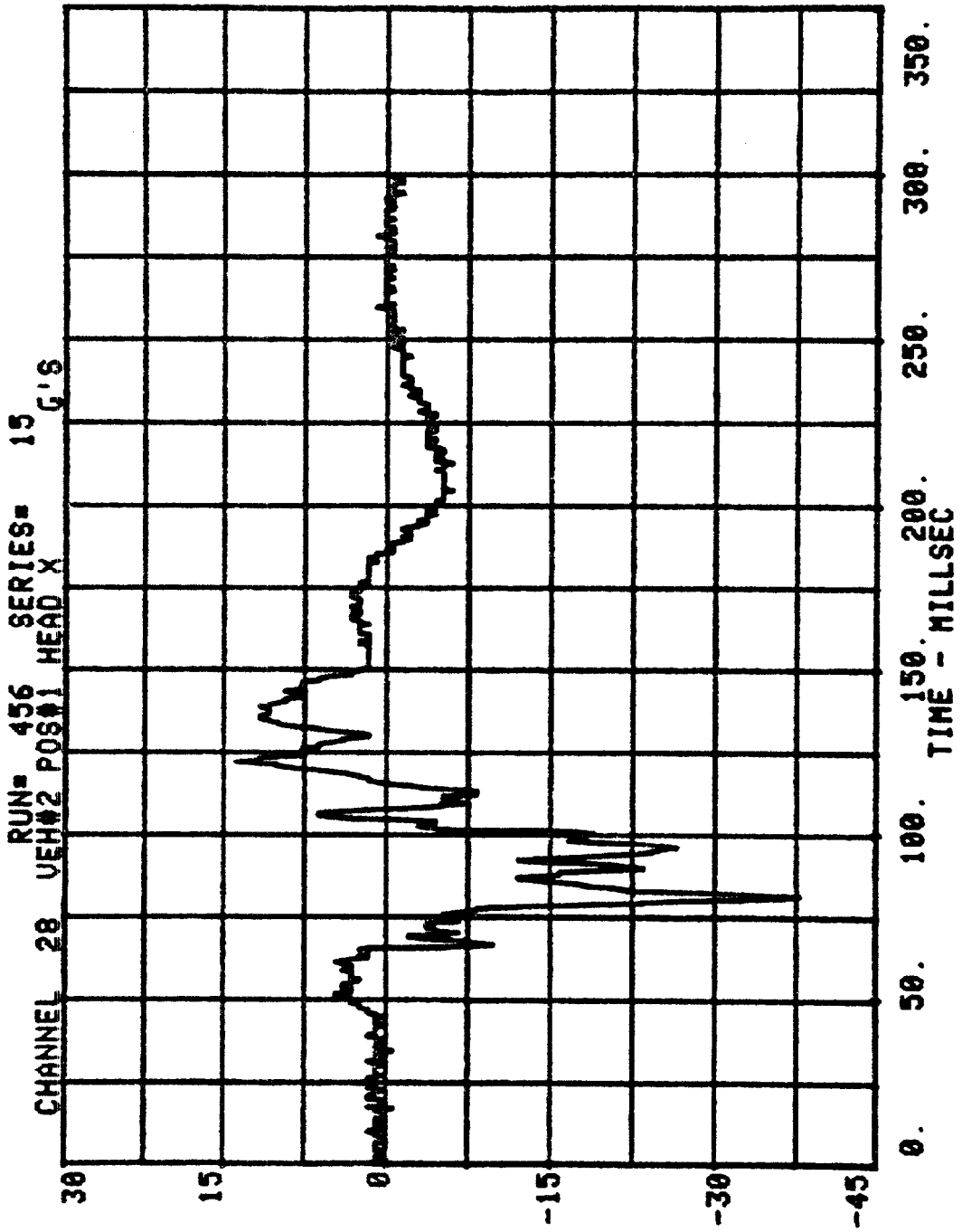
VEH#2 POS#1 HEAD RES.

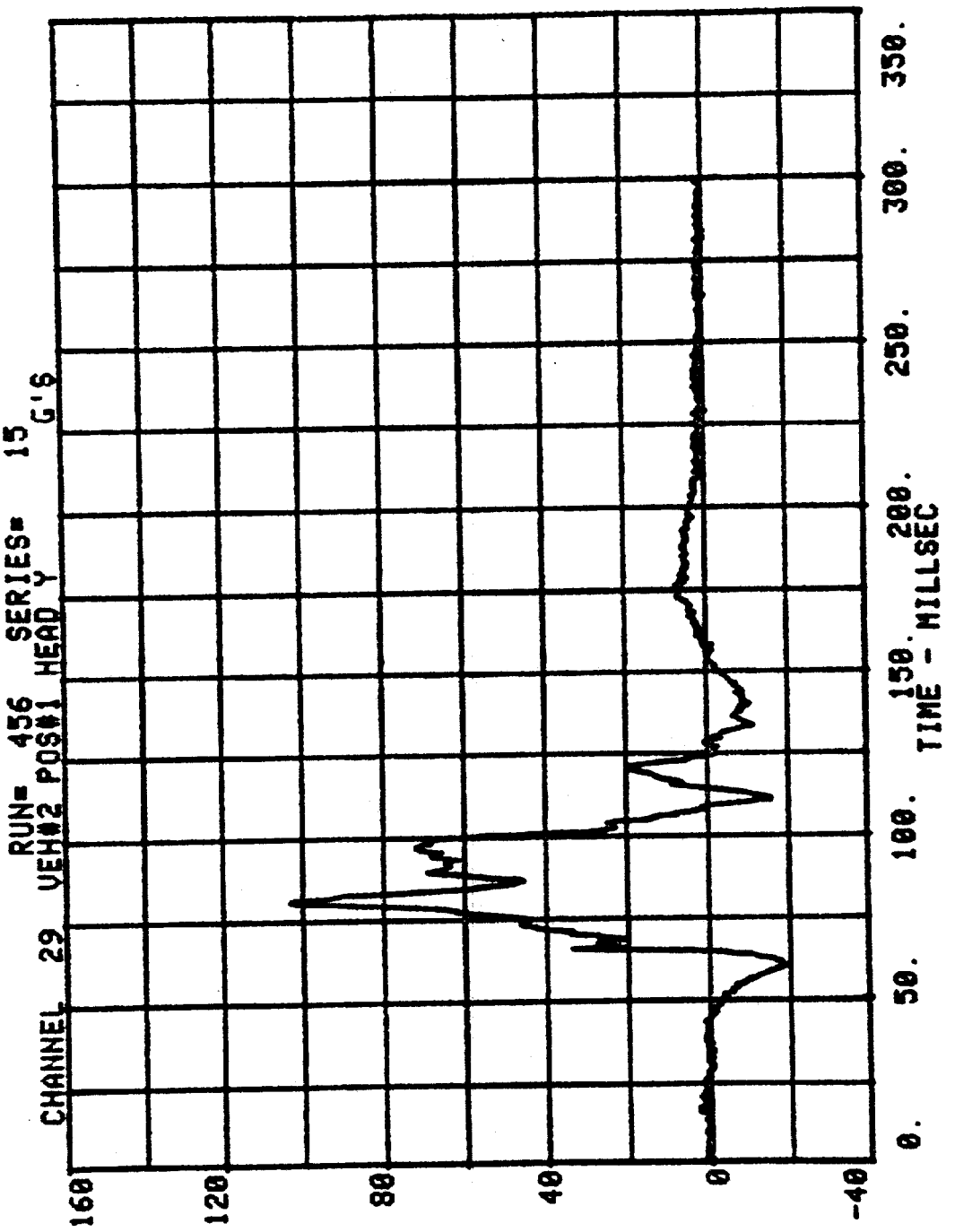
HIC=1298.8 FROM T1= .07050 TO T2= .11100

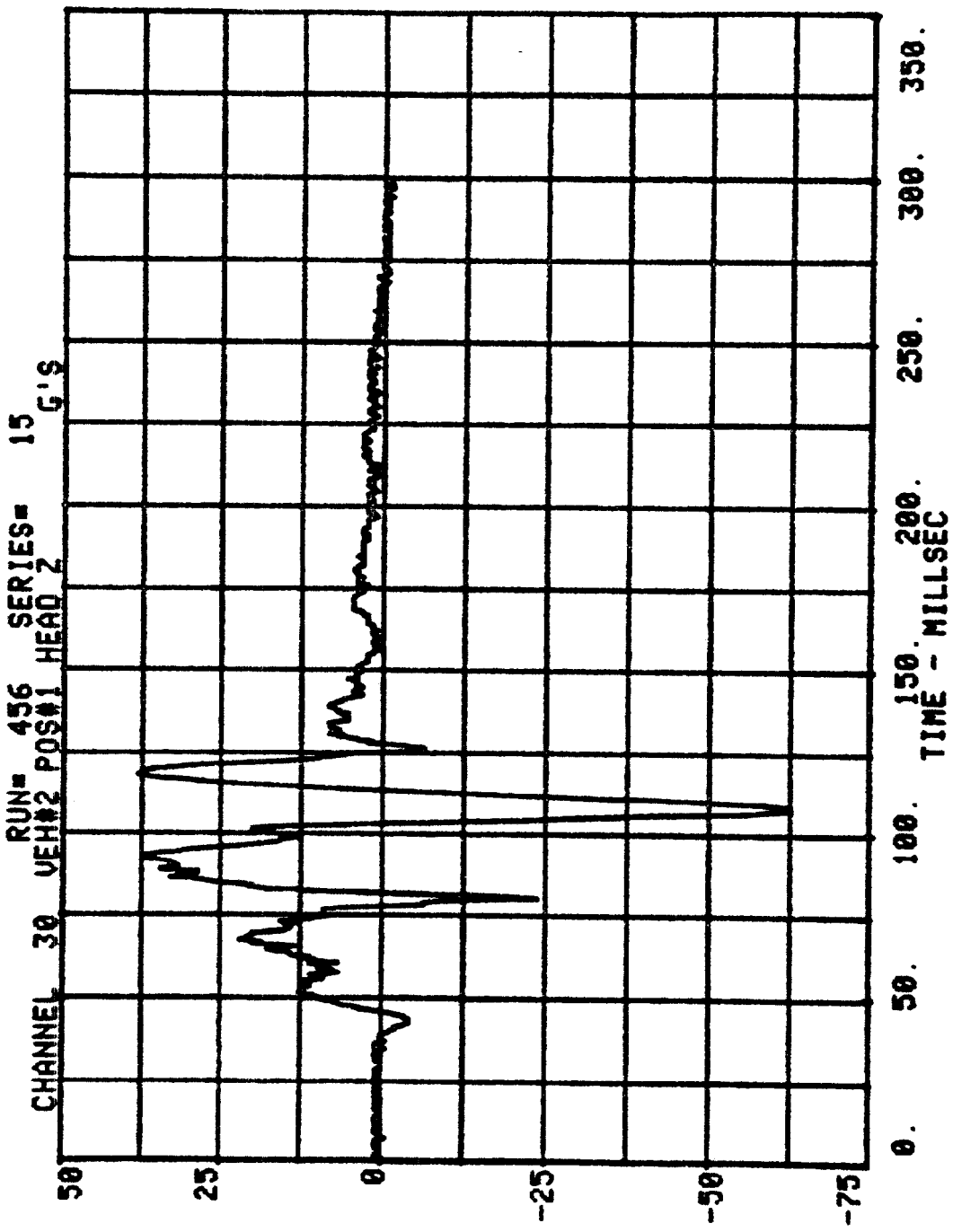
AVERAGE ACCELERATION BETWEEN T1 AND T2= 63.5G'S

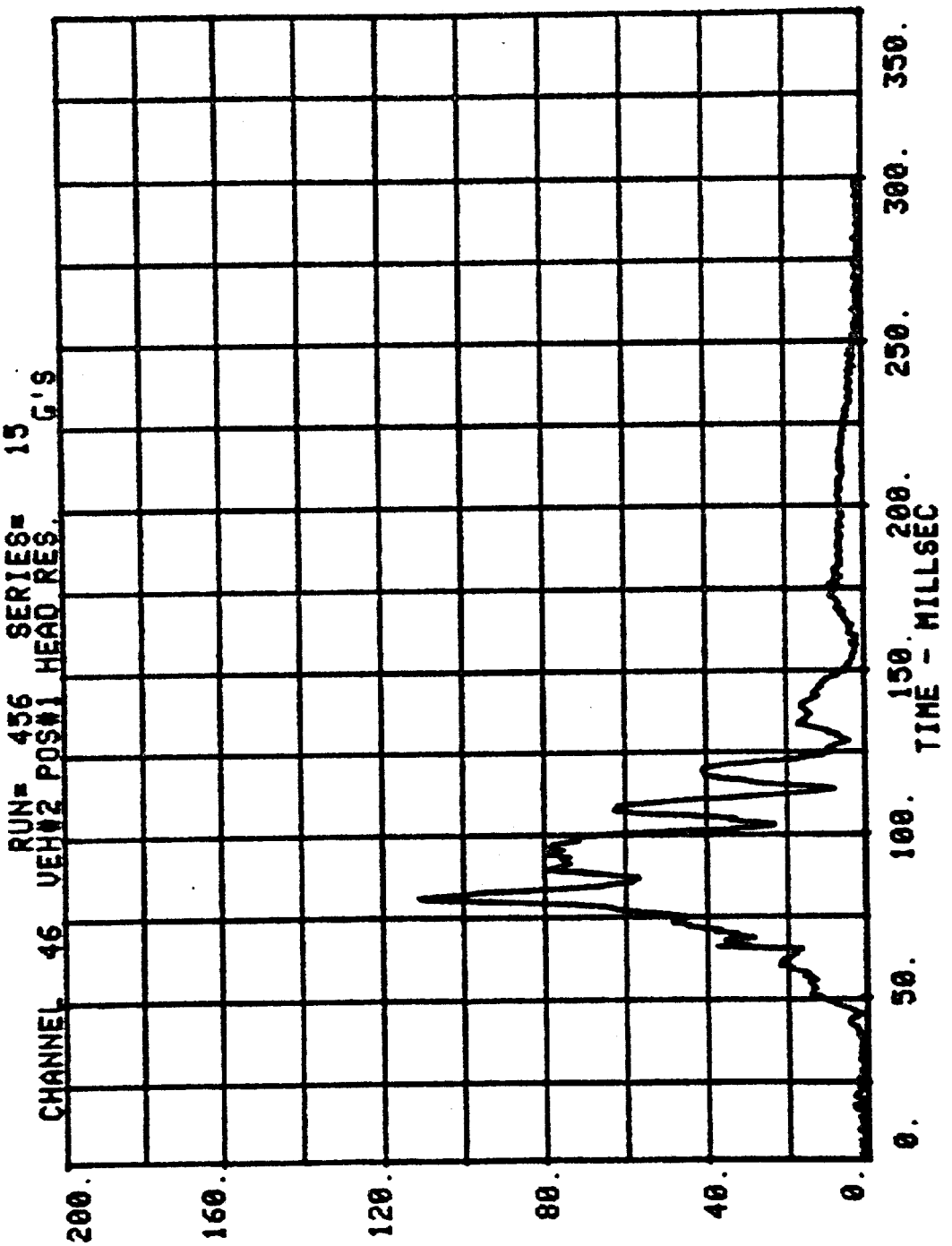
EVENT TIME= 300.0 MSEC

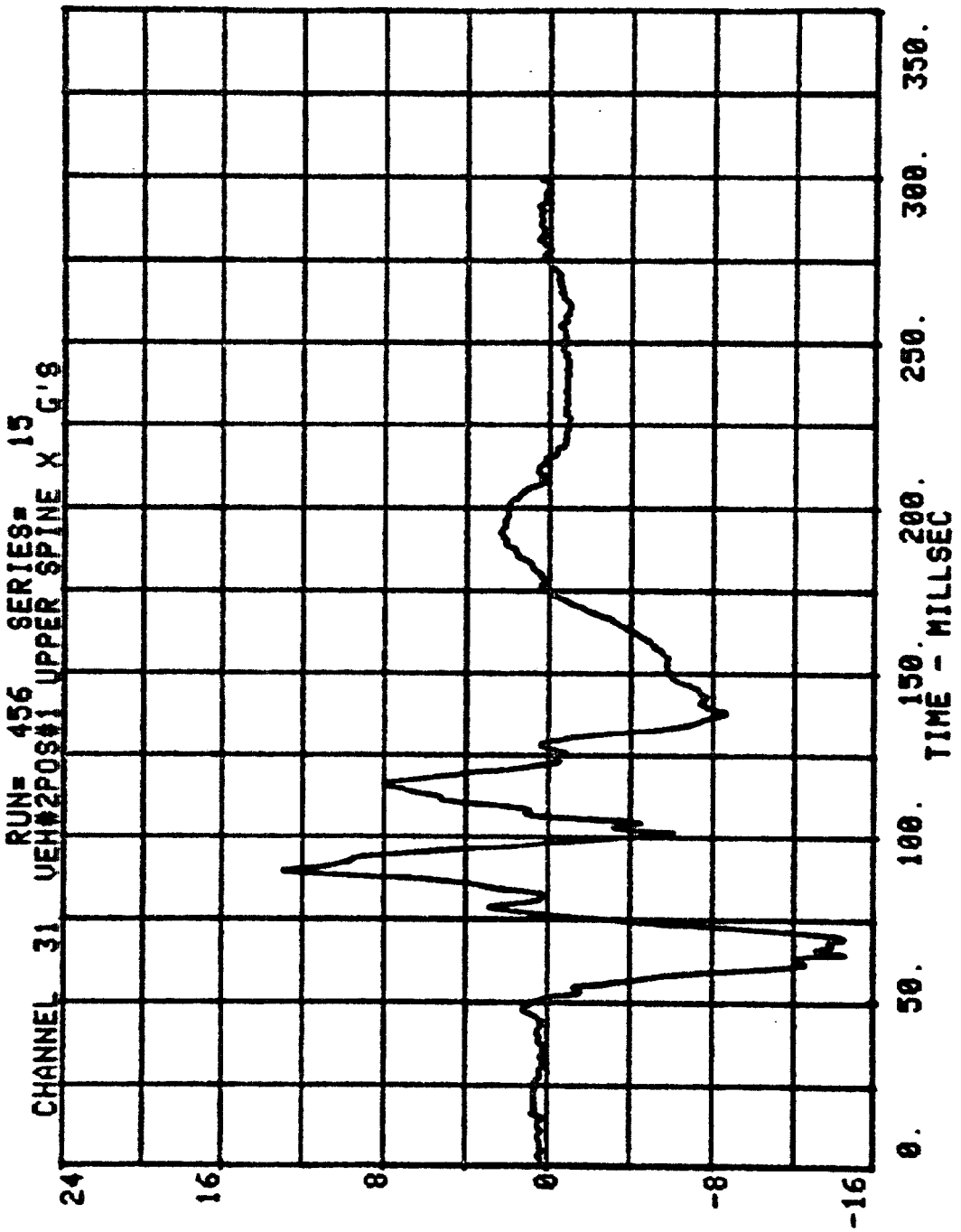
SEVERITY INDEX=1668.5

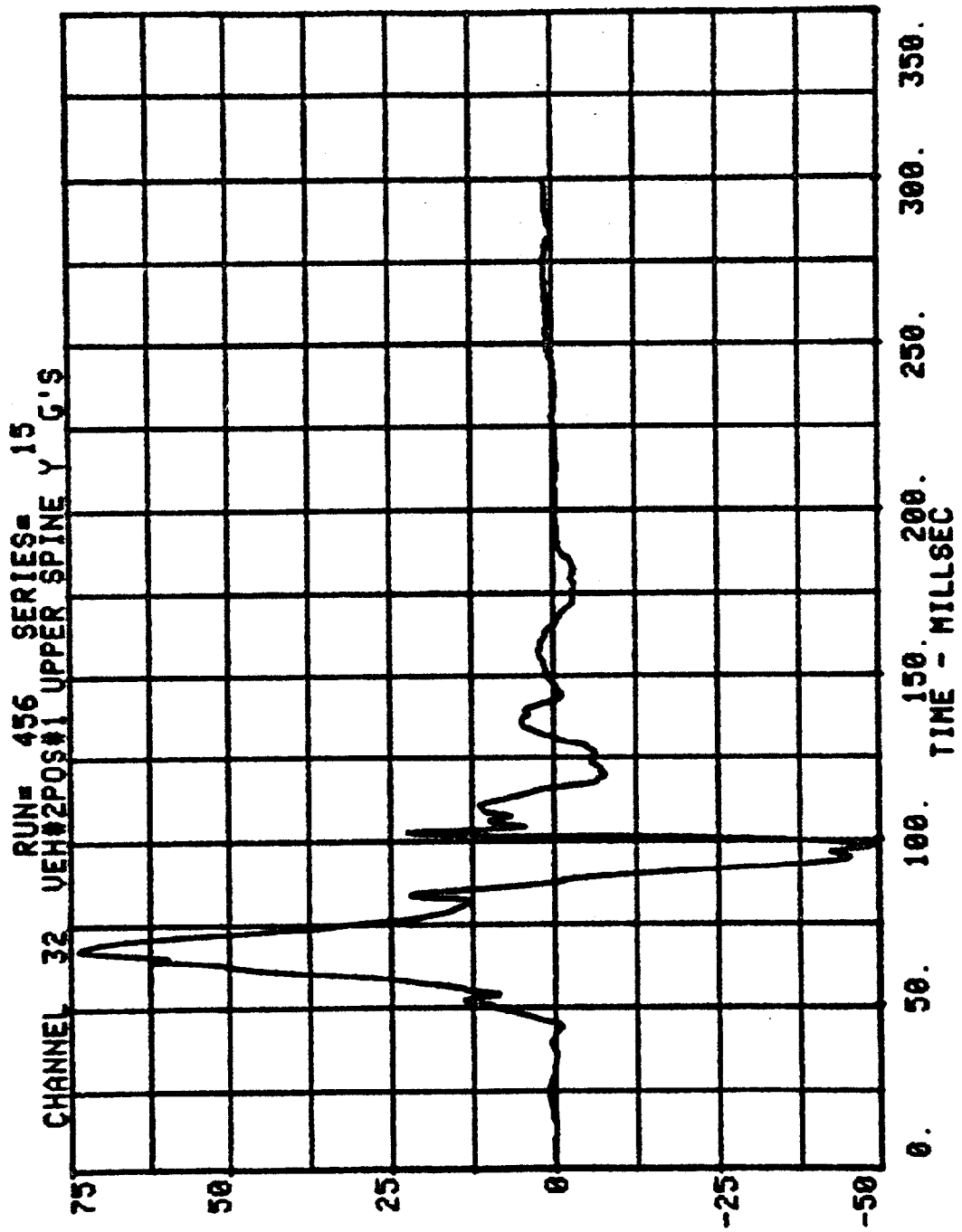

CHANNEL 28 VEH#2 POS#1 HEAD X
RUN= 456 SERIES= 15
G'S
30
15
0
-15
-30
-45
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

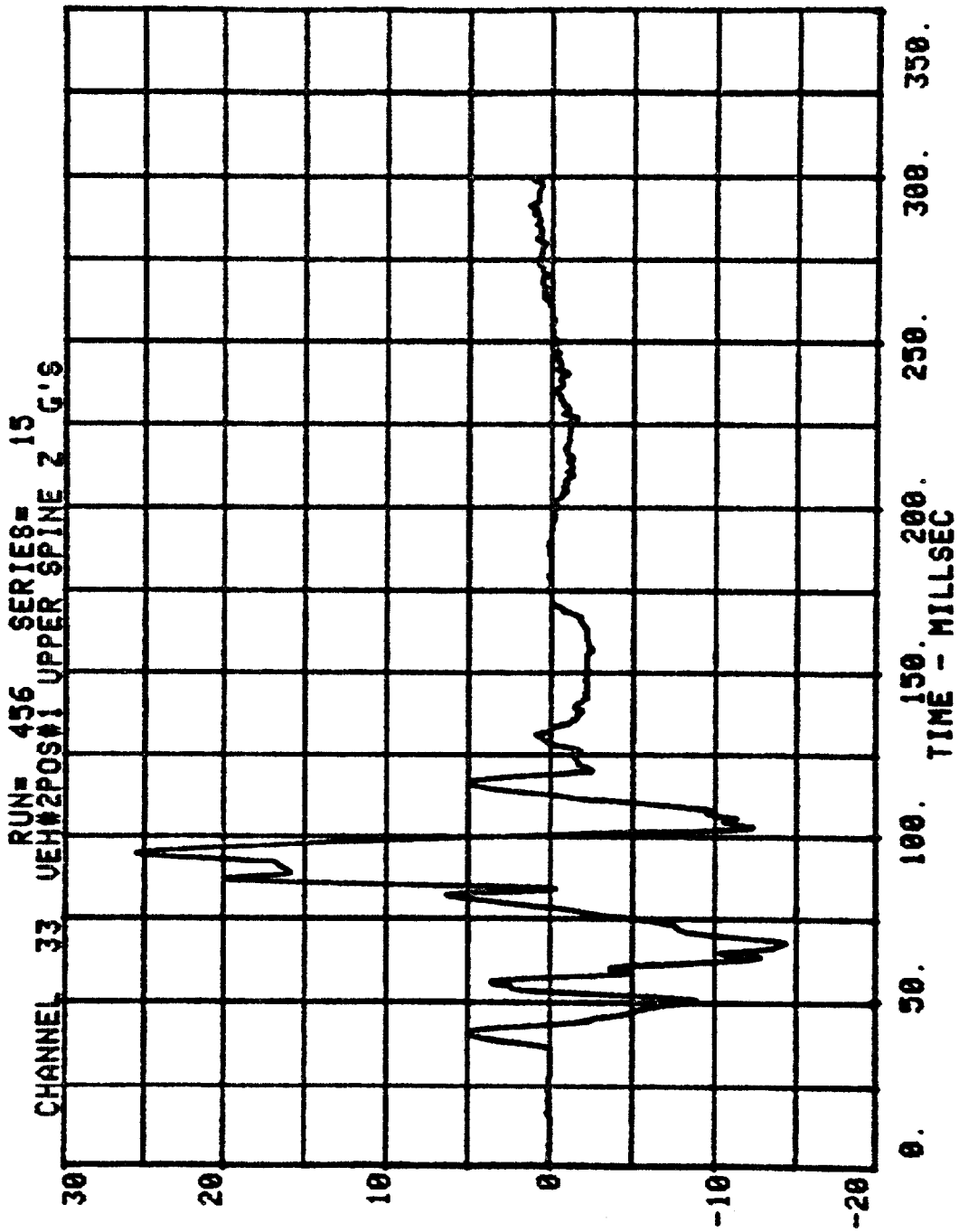

CHANNEL 29
RUN= 456 SERIES= 15
VEH#2 POS#1 HEAD Y
G'S
160
120
80
40
0
-40
0.
50.
100.
150.
200.
250.
300.
350.
TIME = MILLSEC

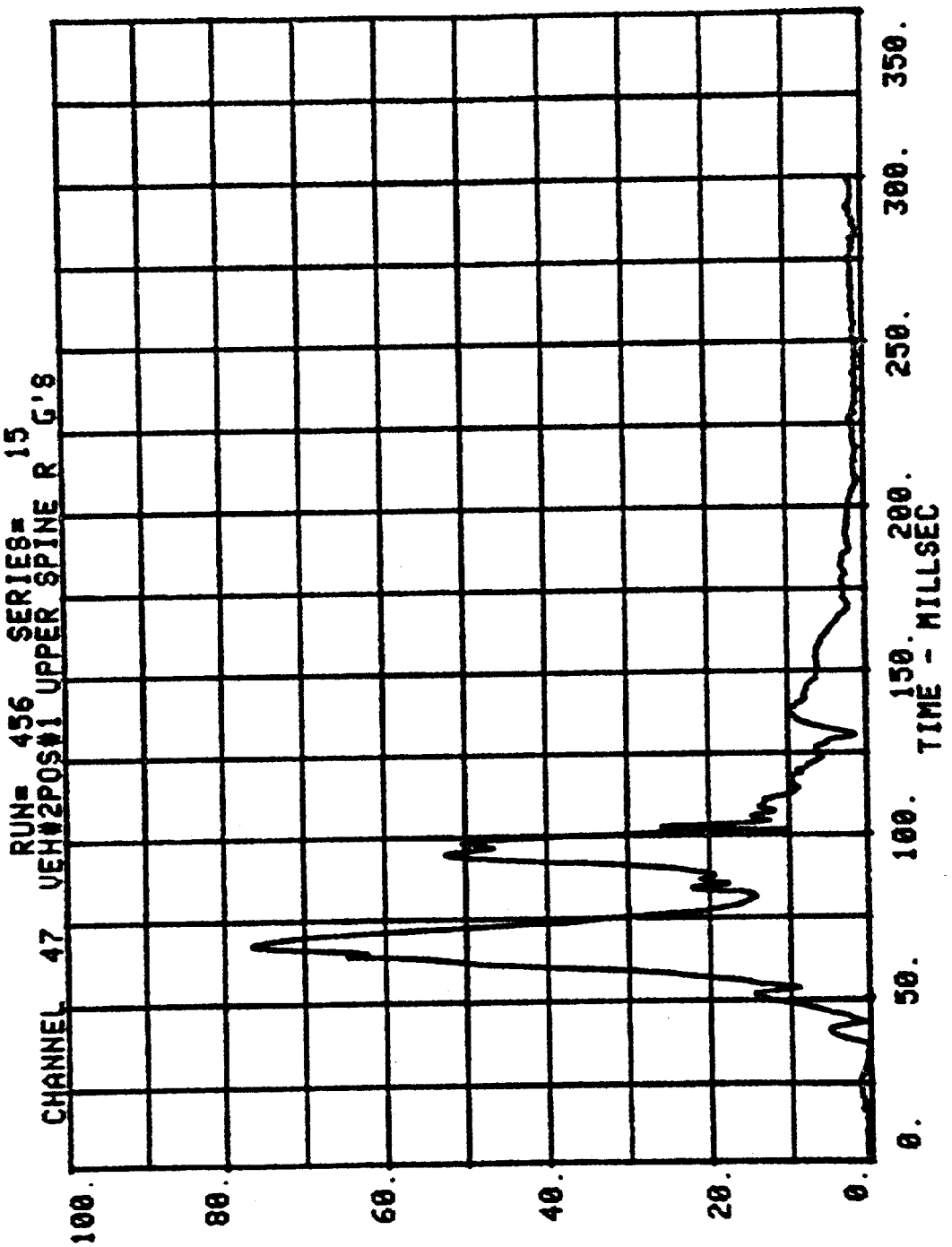

CHANNEL 30 VEH#2 POS#1 HEAD 2
RUN= 456 SERIES= 15
G'S
50
25
0
-25
-50
-75
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

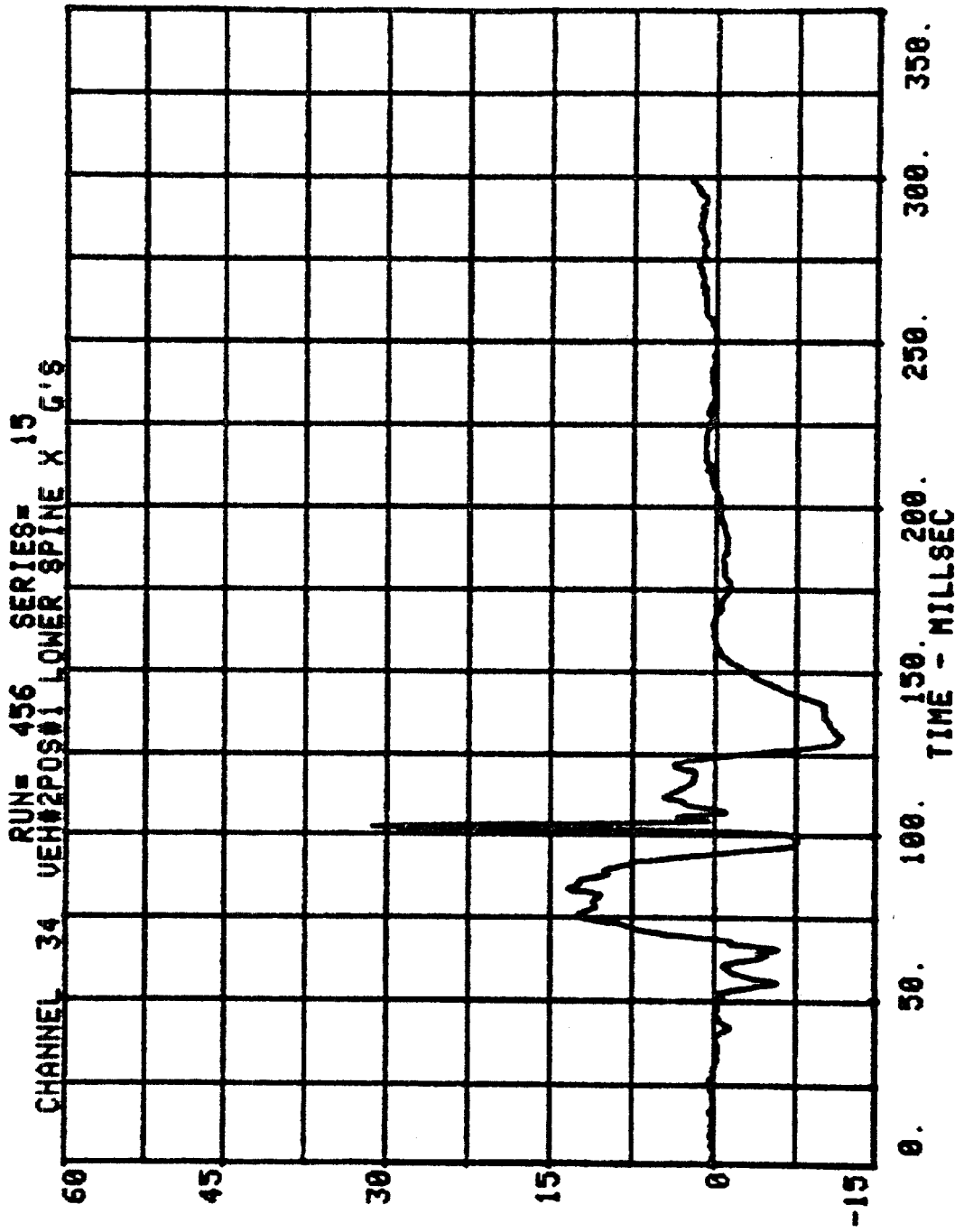

CHANNEL 46 RUN= 456 SERIES= 15
VEH#2 POS#1 HEAD RES.
G'S
200.
160.
120.
80.
40.
0.
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

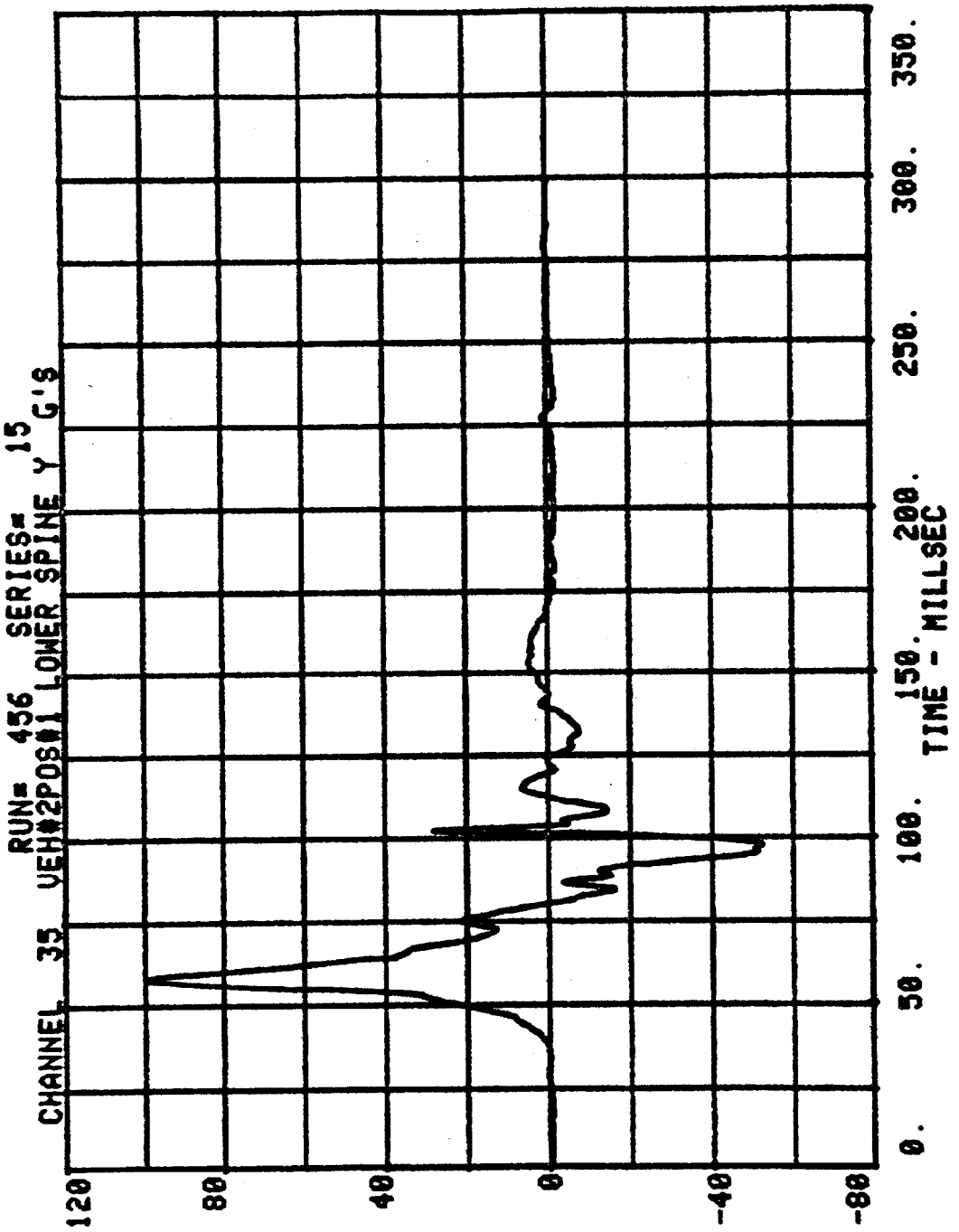

CHANNEL 31 VEH#2POS#1 UPPER SPINE X G'S
RUN= 456 SERIES= 15
24
16
8
0
-8
-16
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

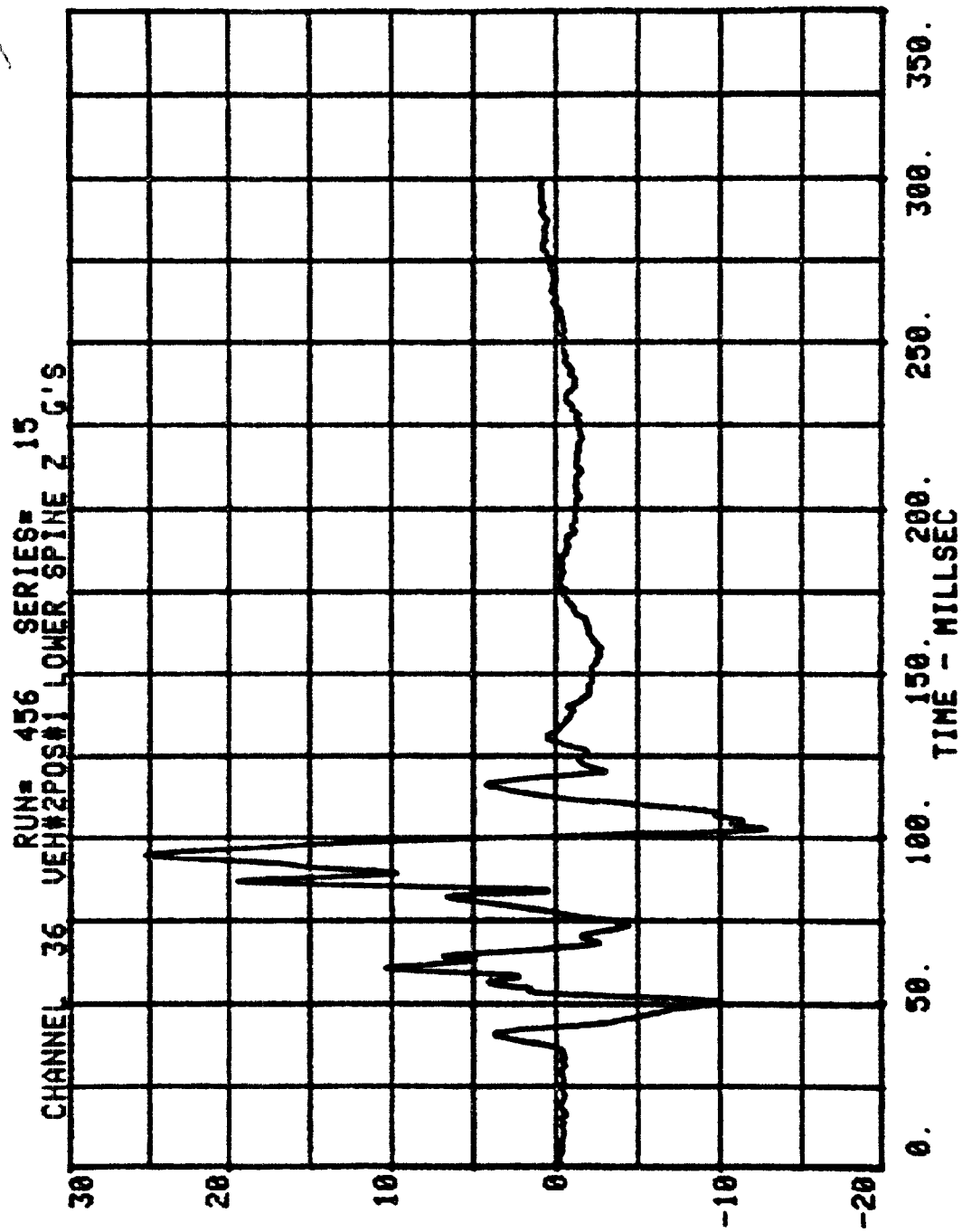

CHANNEL 32 VEH#2POS#1 UPPER SPINE Y G'S
RUN= 456 SERIES= 15
75
50
25
0
-25
-50
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

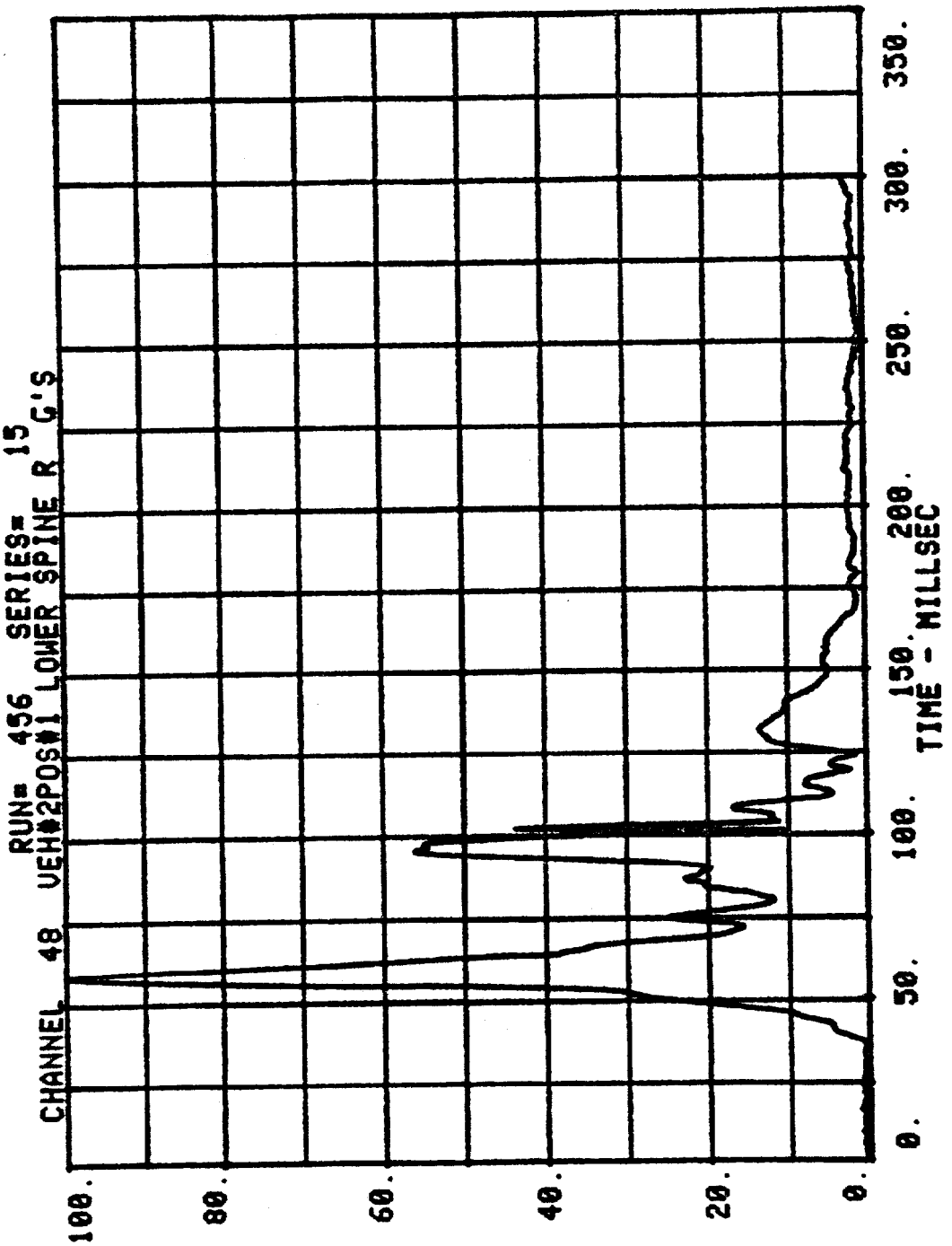

CHANNEL 33 VEH#2POS#1 UPPER SPINE Z G'S
RUN= 456 SERIES= 15
30
20
10
0
-10
-20
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

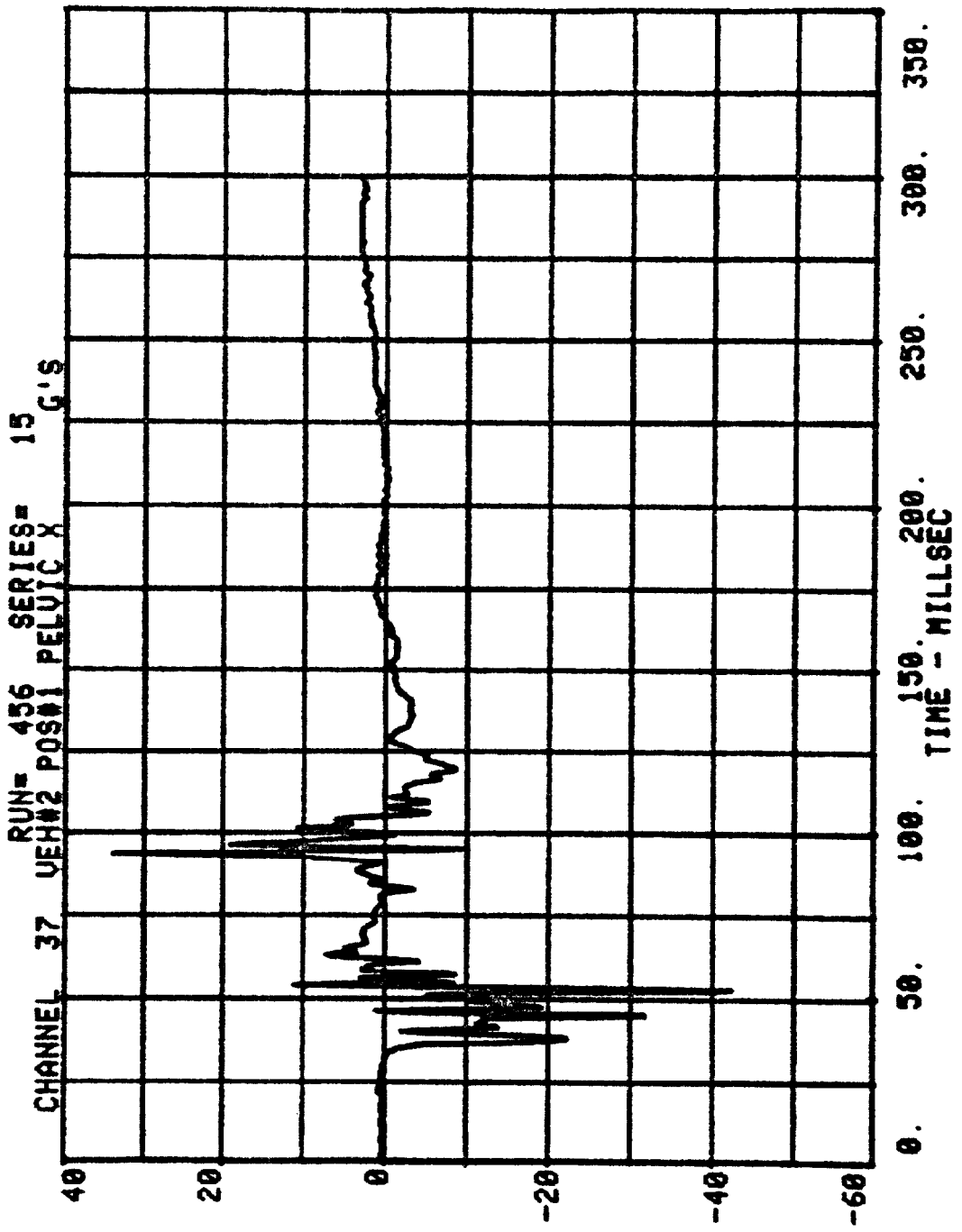

CHANNEL 47 VEH#2POS#1 UPPER SPINE R G'S
RUN= 456 SERIES= 15
100.
80.
60.
40.
20.
0.
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

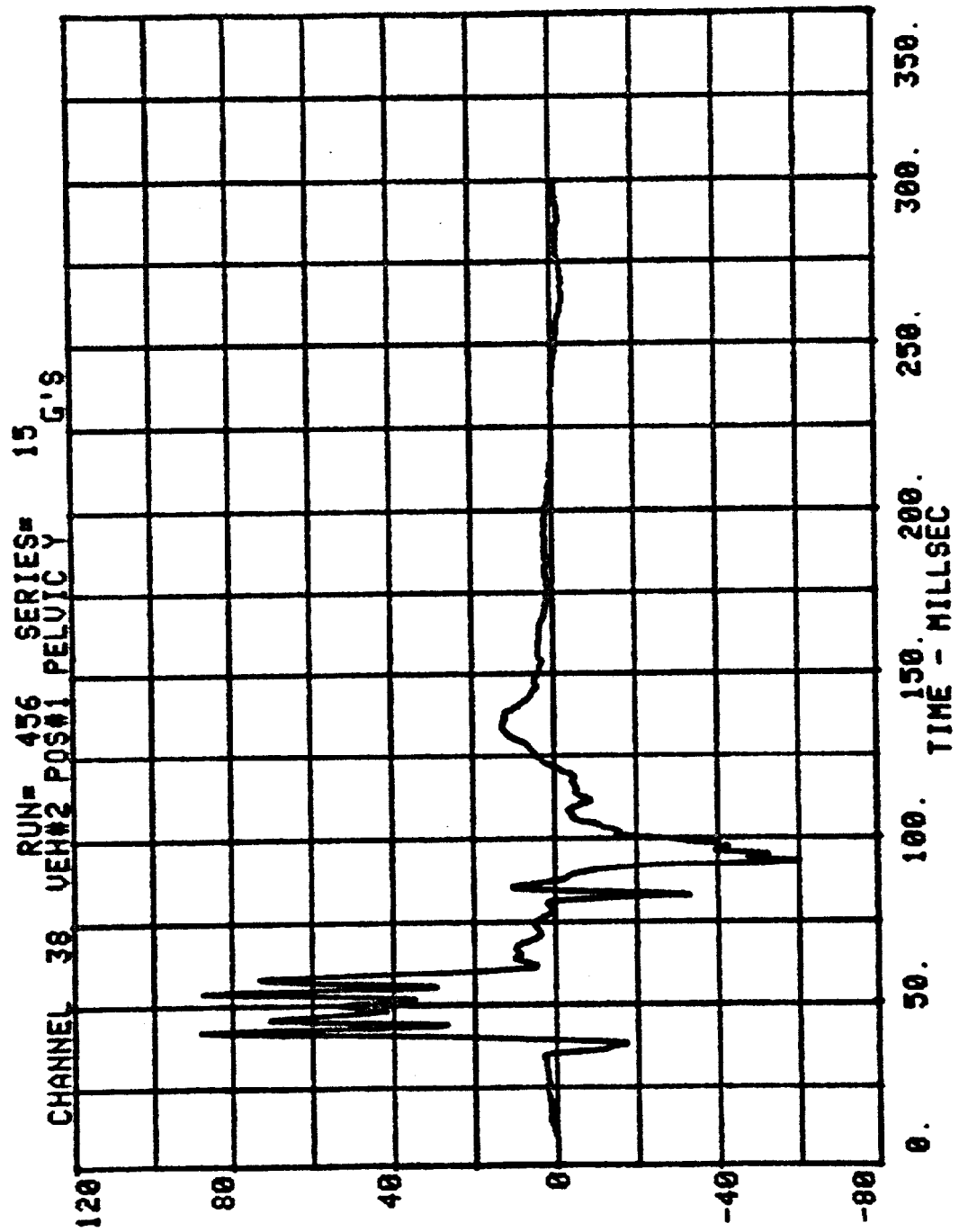

CHANNEL 34 VEH#2POS#1 LOWER SPINE X G'S
RUN= 456 SERIES= 15
60
45
30
15
0
-15
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 35 VEH#2POS#1 LOWER SPINE Y
RUN= 456 SERIES= 15
G'S
120
80
40
0
-40
-80
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

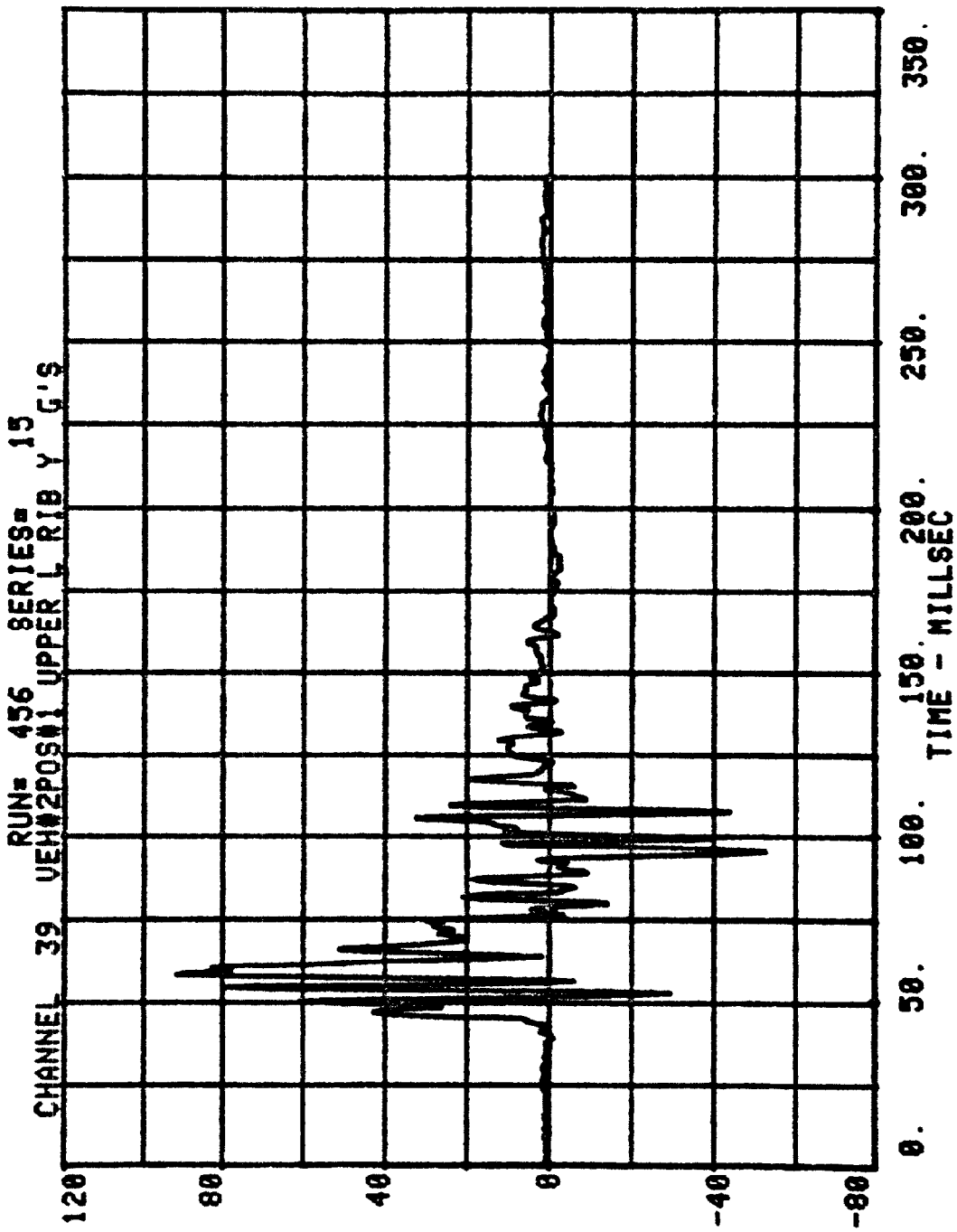

CHANNEL 36 VEH#2POS#1 LOWER SPINE Z G'S
RUN= 456 SERIES= 15
30
20
10
0
-10
-20
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

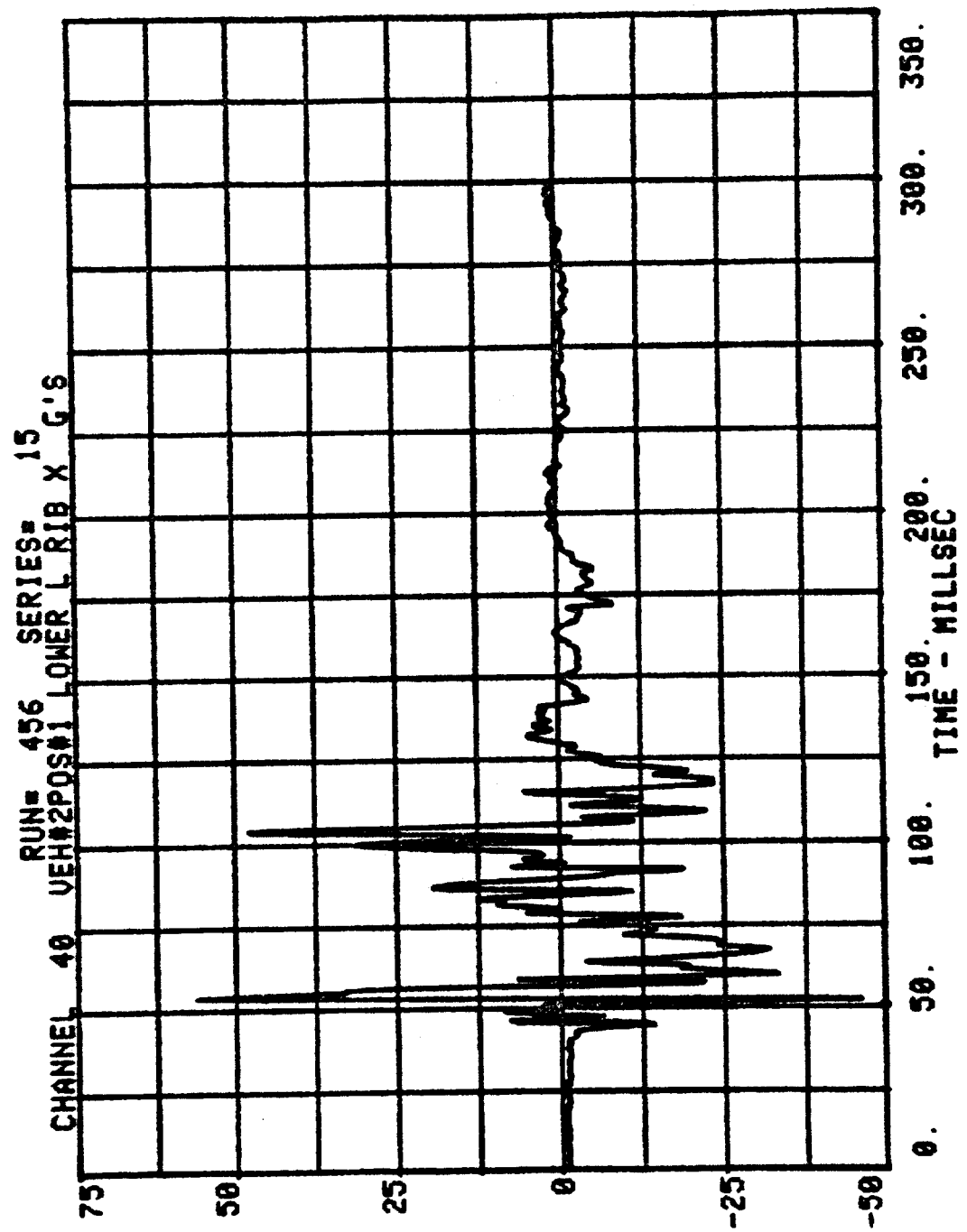

CHANNEL 48 VEH#2POS#1 LOWER SPINE R
RUN= 456 SERIES= 15
G'S
100.
80.
60.
40.
20.
0.
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

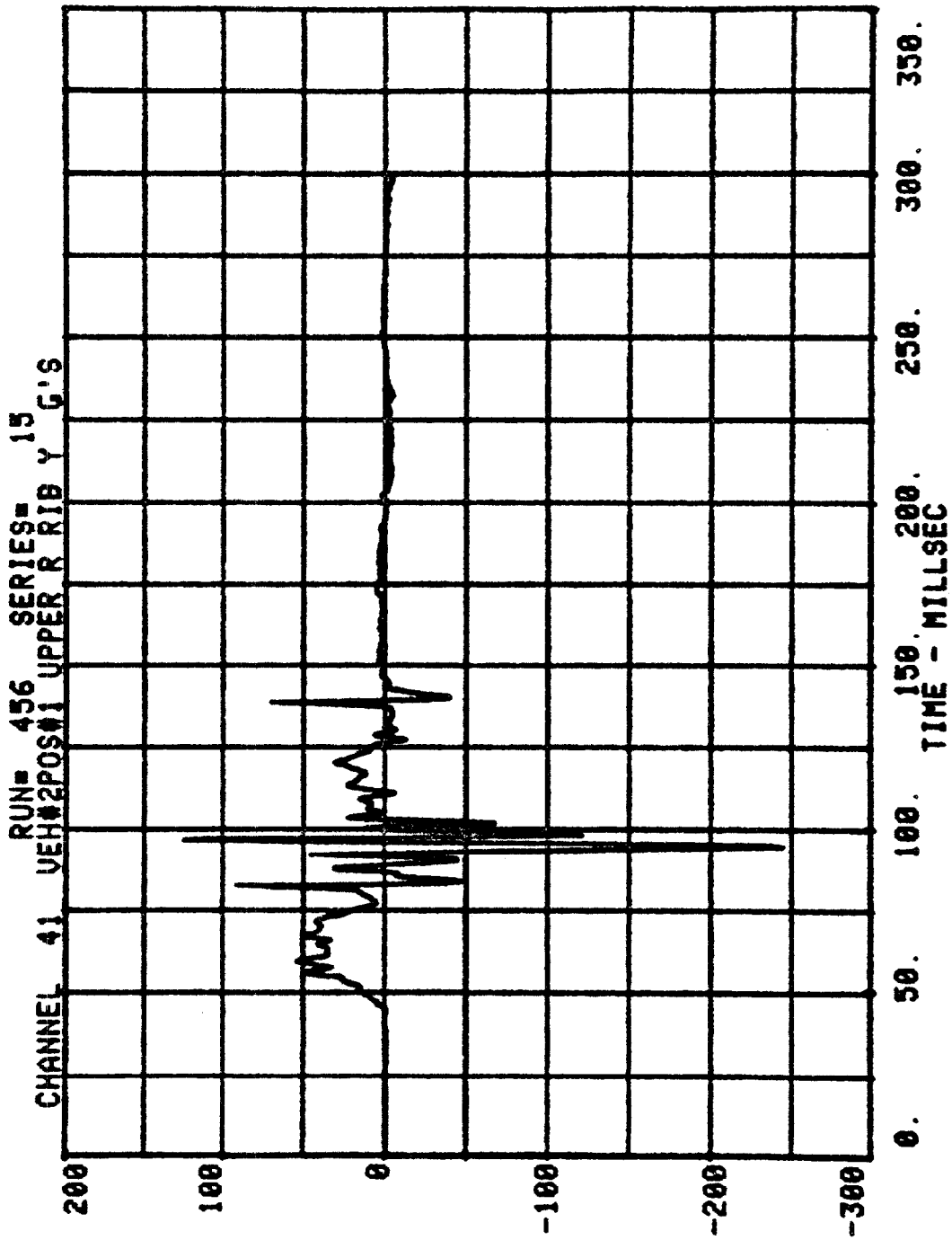

CHANNEL 37 VEH#2 POS#1 PELVIC X
RUN= 456 SERIES= 15
G'S
40
20
0
-20
-40
-60
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

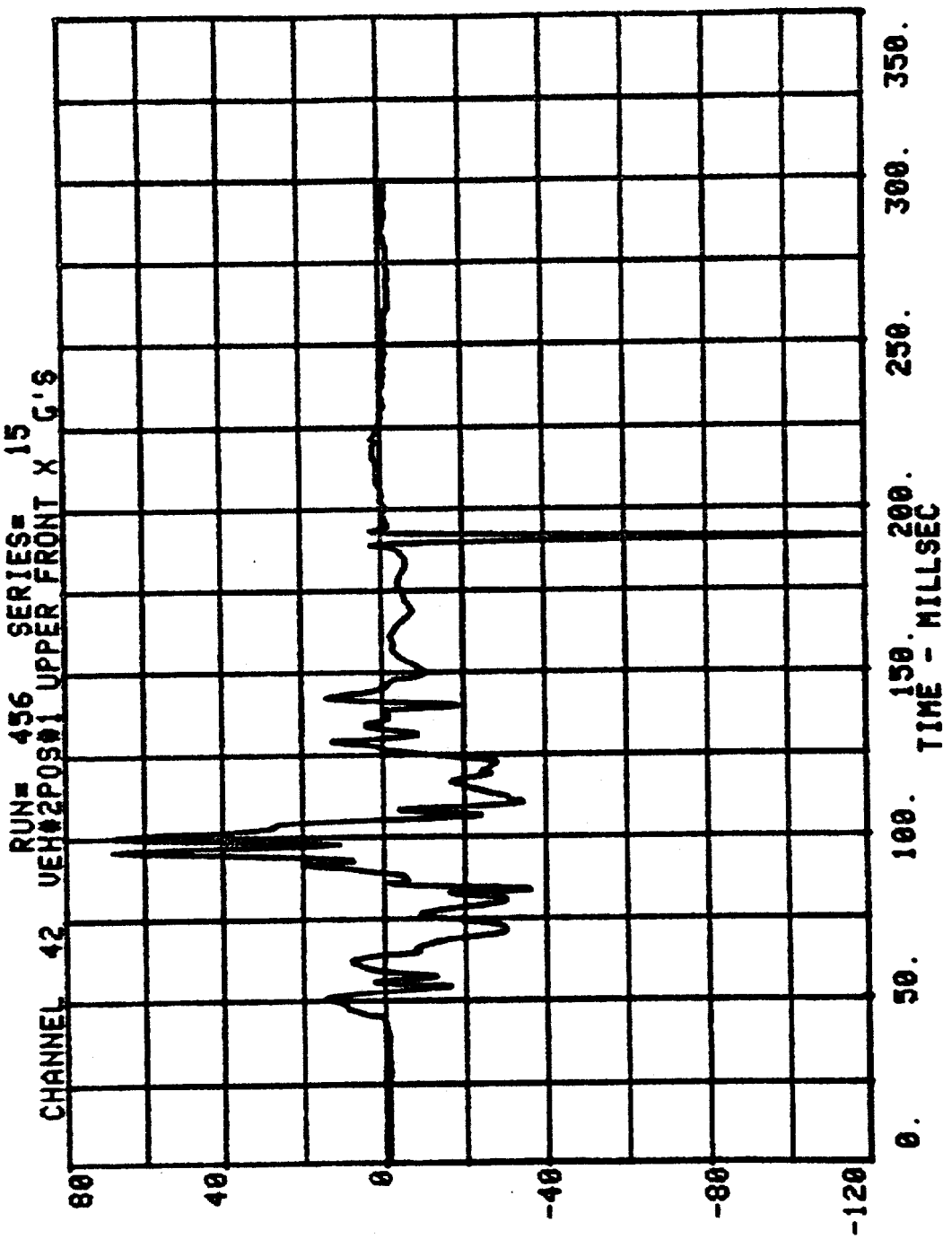

CHANNEL 38 VEH#2 POS#1 PELVIC Y
RUN= 456 SERIES= 15
G'S
120
80
40
0
-40
-80
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

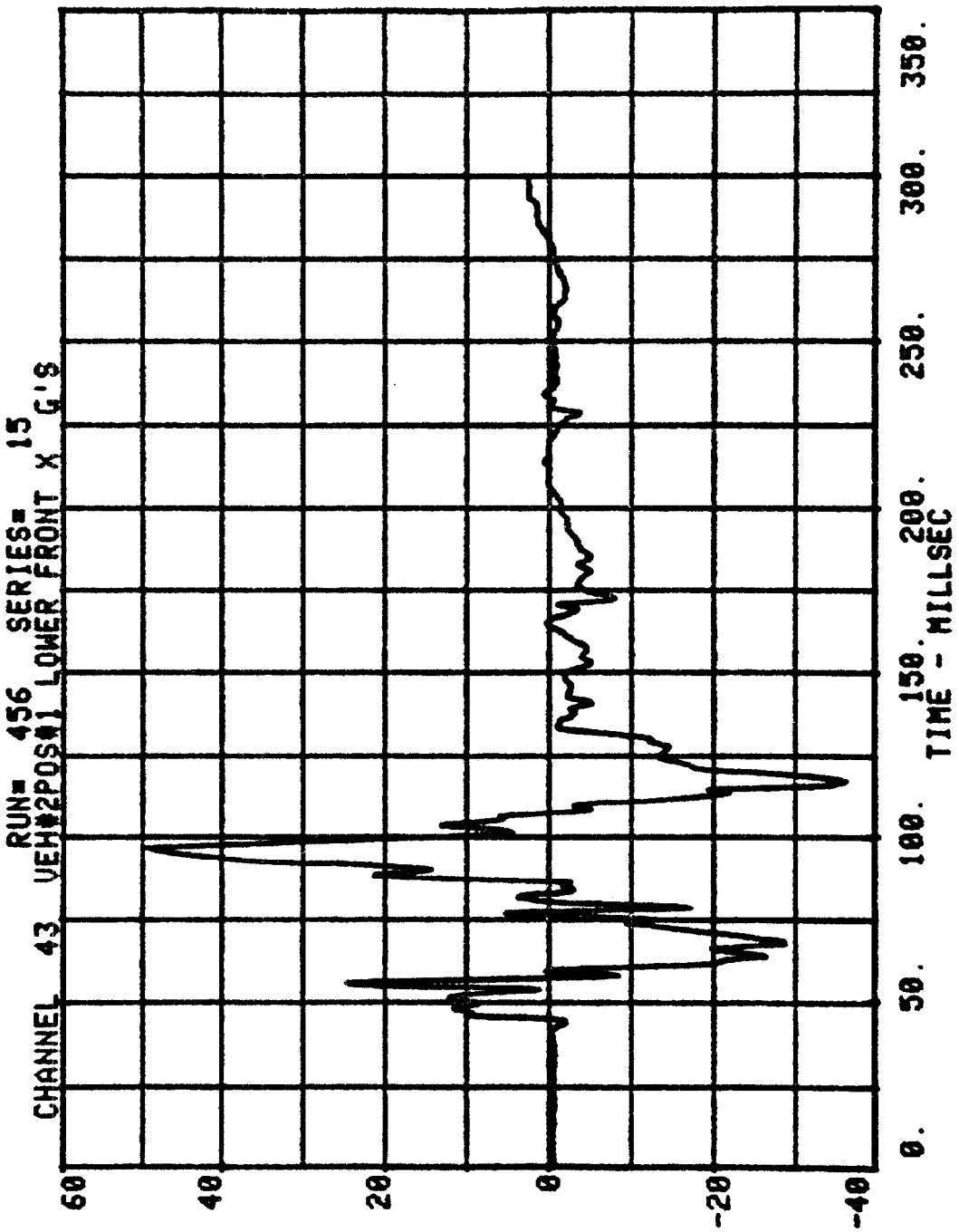
(39)


CHANNEL 39 VEH#2POS#1 UPPER L RIB Y G'S
RUN= 456 SERIES= 15
120
80
40
0
-40
-80
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

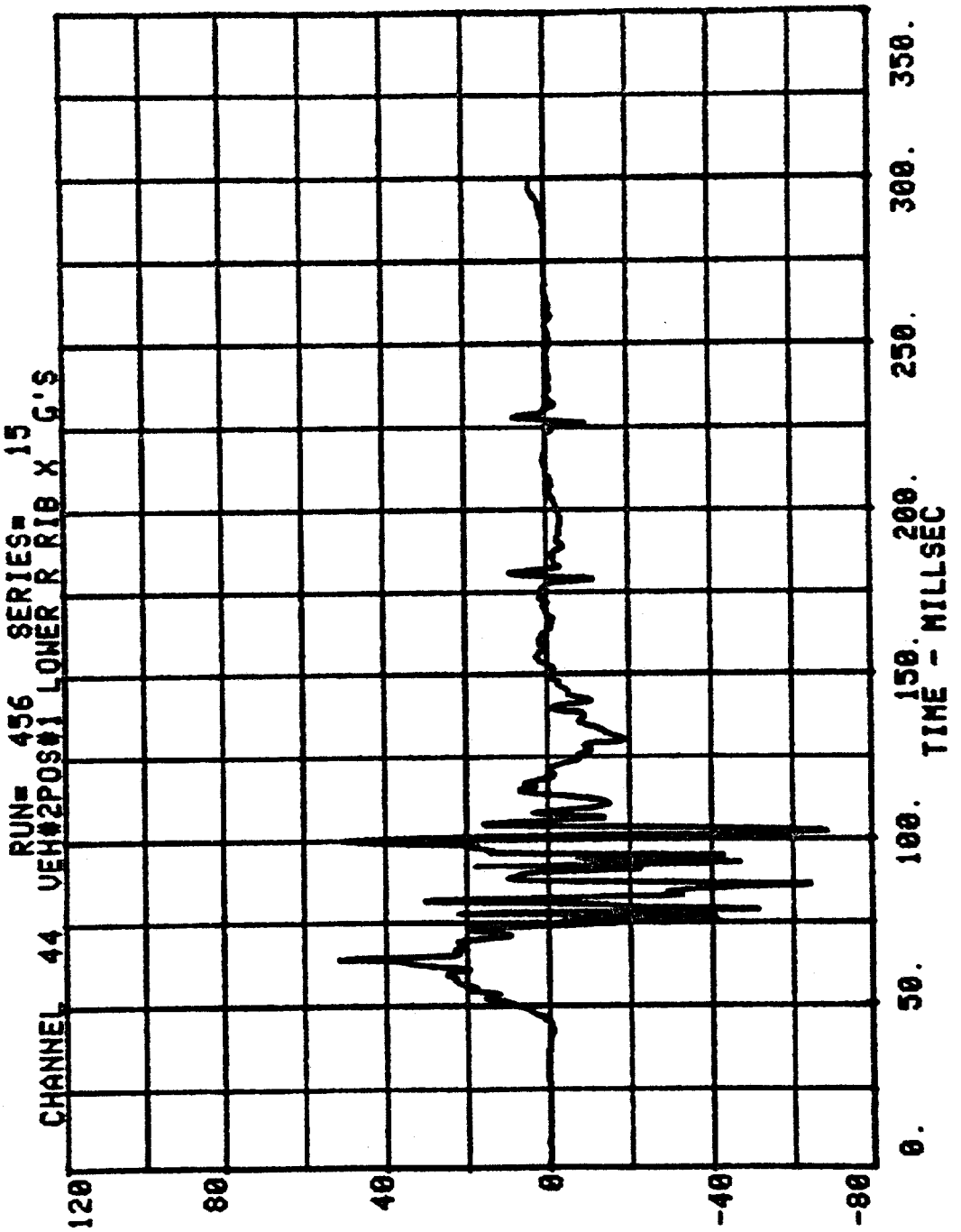

CHANNEL 40 VEH#2POS#1 LOWER L RIB X G'S
RUN= 456 SERIES= 15
75
50
25
0
-25
-50
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 41 VEH#2POS#1 UPPER R RIB Y
RUN= 456 SERIES= 15
G'S
200
100
0
-100
-200
-300
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 42 VEH#2POS#1 UPPER FRONT X G'S
RUN= 456 SERIES= 15
80
40
0
-40
-80
-120
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 43 VEH#2POS#1 LOWER FRONT X G'S
RUN= 456 SERIES= 15
60
40
20
0
-20
-40
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

(14)


CHANNEL 44 VEH#2POS#1 LOWER R RIB X G'S
RUN= 456 SERIES= 15
120
80
40
0
-40
-80
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

HEAD INJURY CRITERION
HEAD SEVERITY INDEX

BUDD #15 SIDE IMPACT TEST

RUN= 456

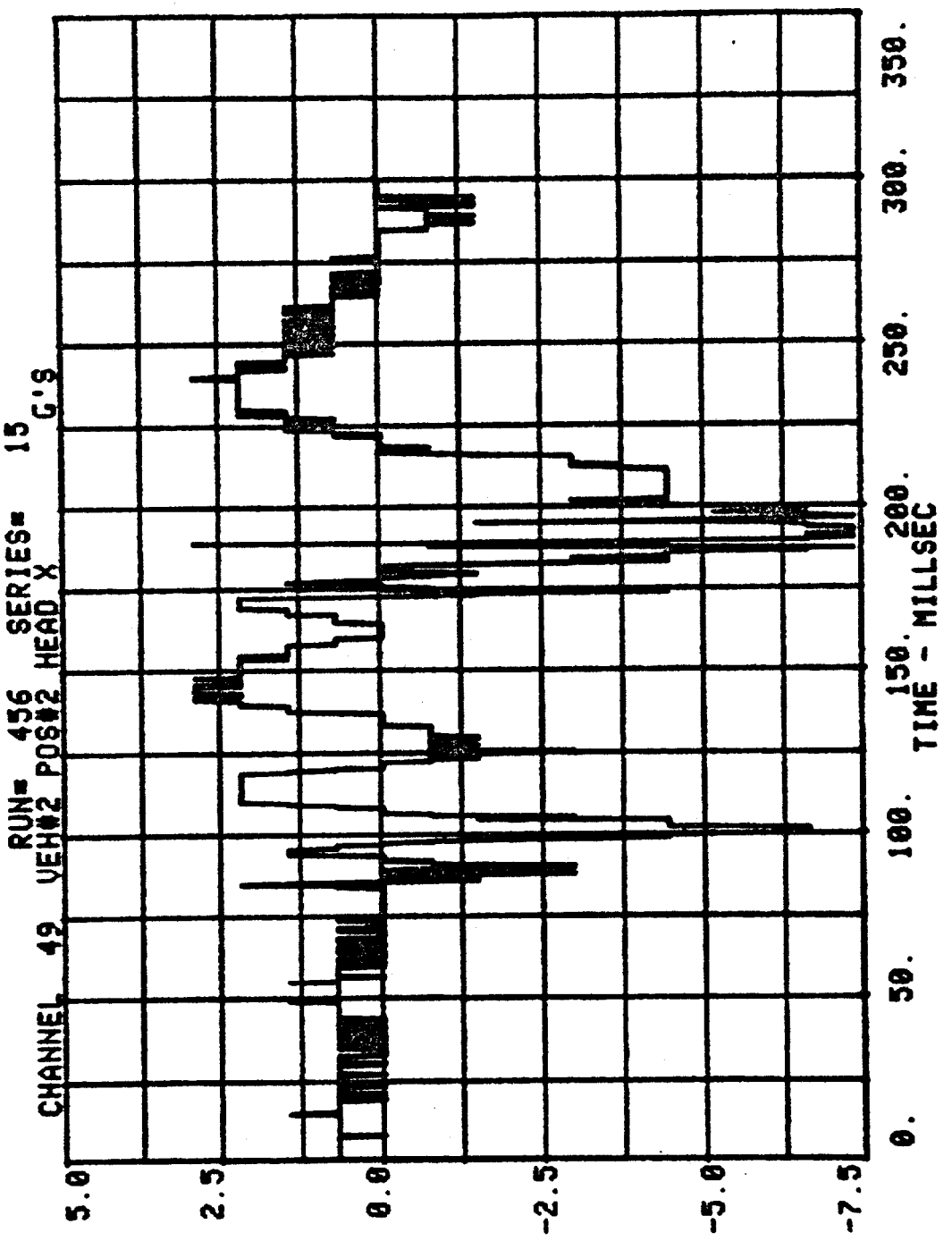
VEH#2 POS#2 HEAD RES.

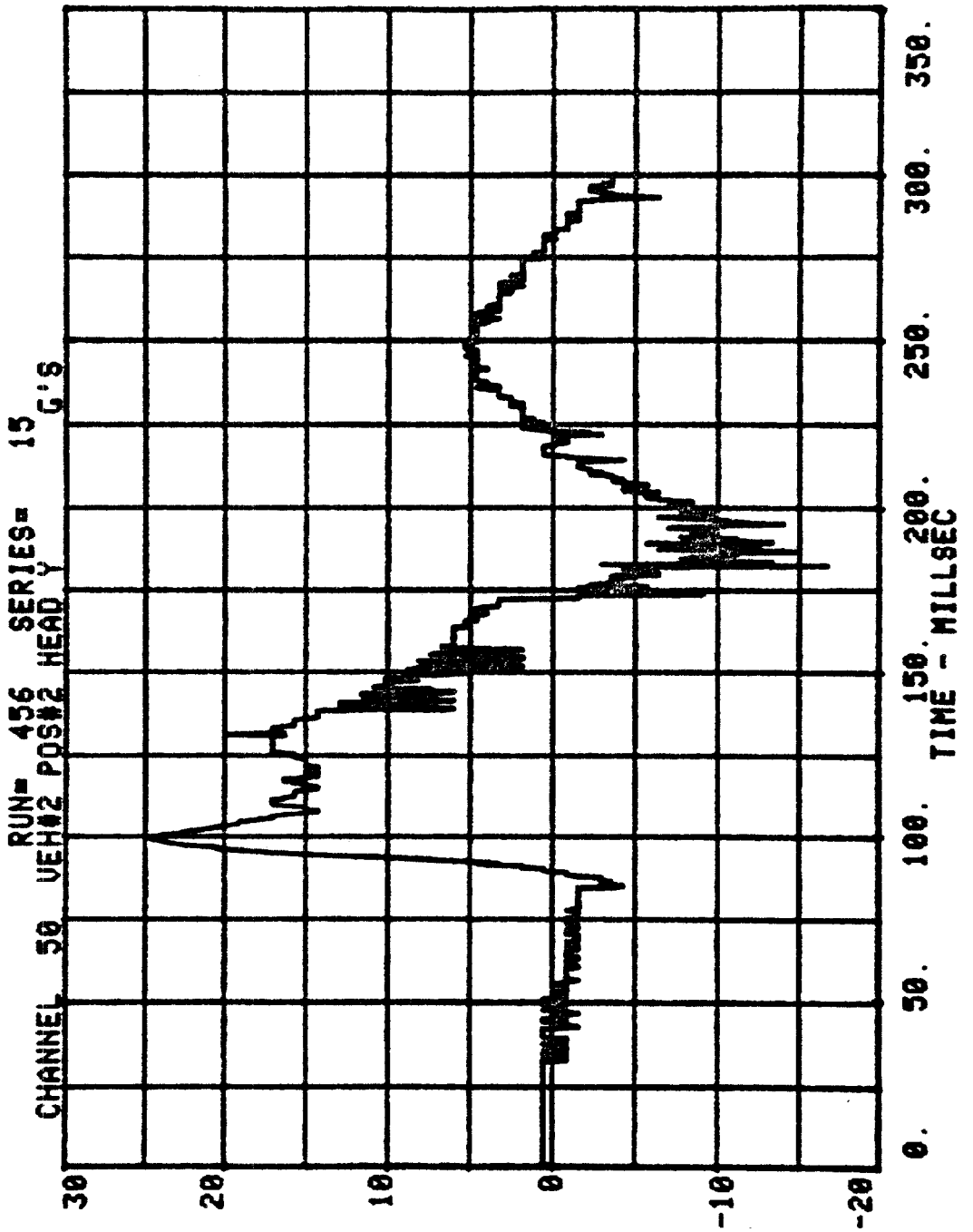
HIC= 78.9 FROM T1= .09390 TO T2= .14940

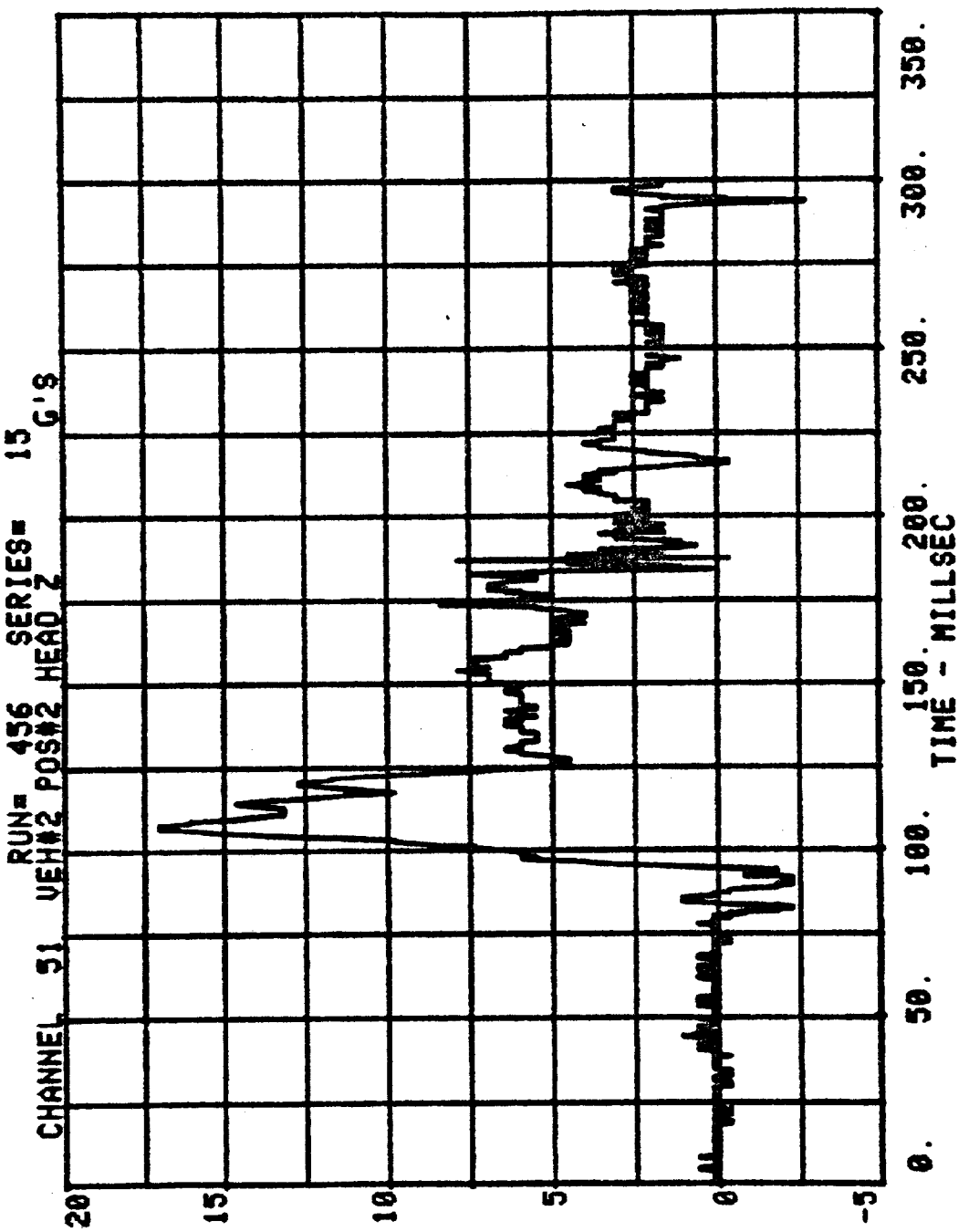
AVERAGE ACCELERATION BETWEEN T1 AND T2= 18.2G'S

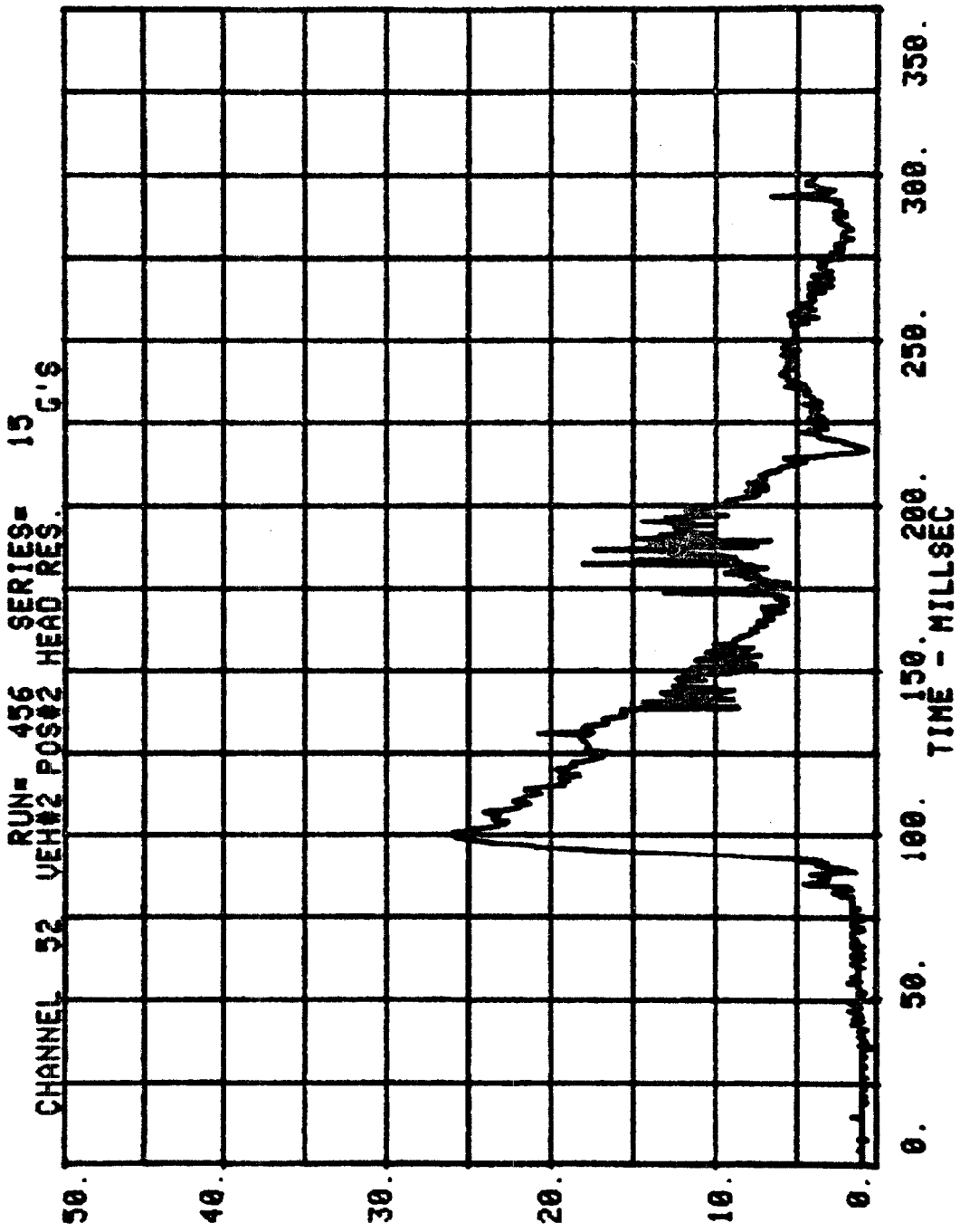
EVENT TIME= 300.0 MSEC

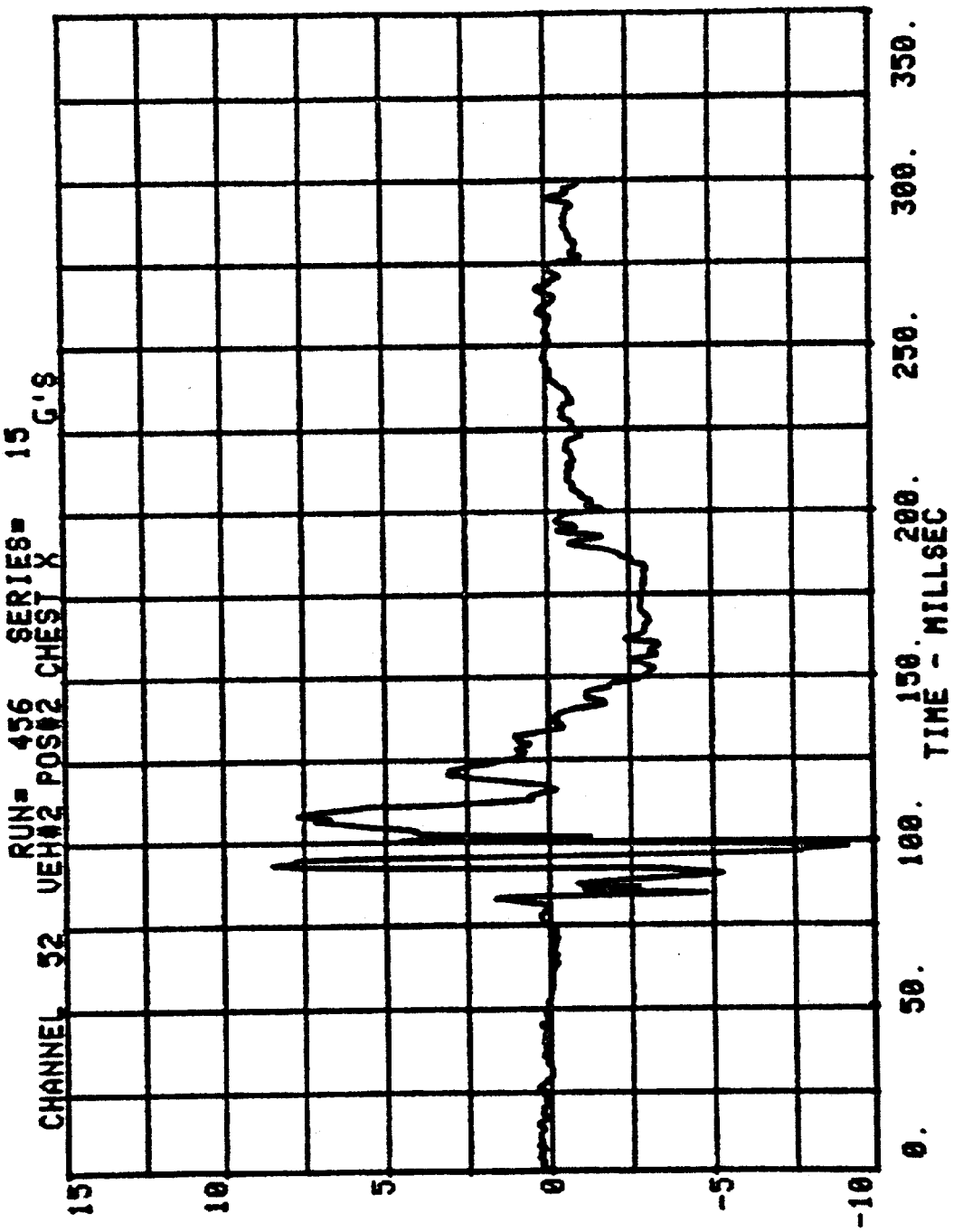
SEVERITY INDEX= 108.2

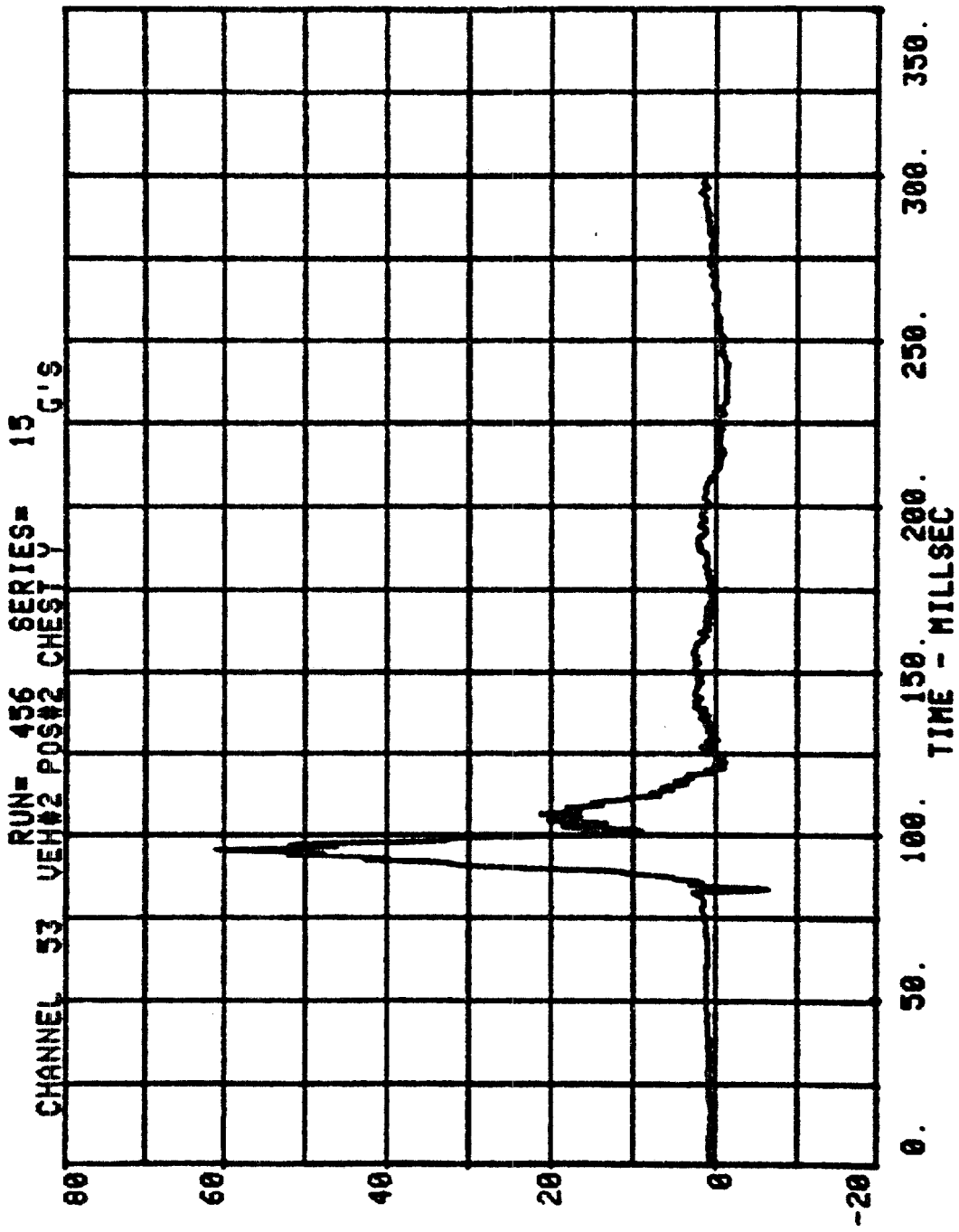

CHANNEL 49 VEH#2 POS#2 HEAD X
RUN= 456 SERIES= 15
G'S
5.0
2.5
0.0
-2.5
-5.0
-7.5
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

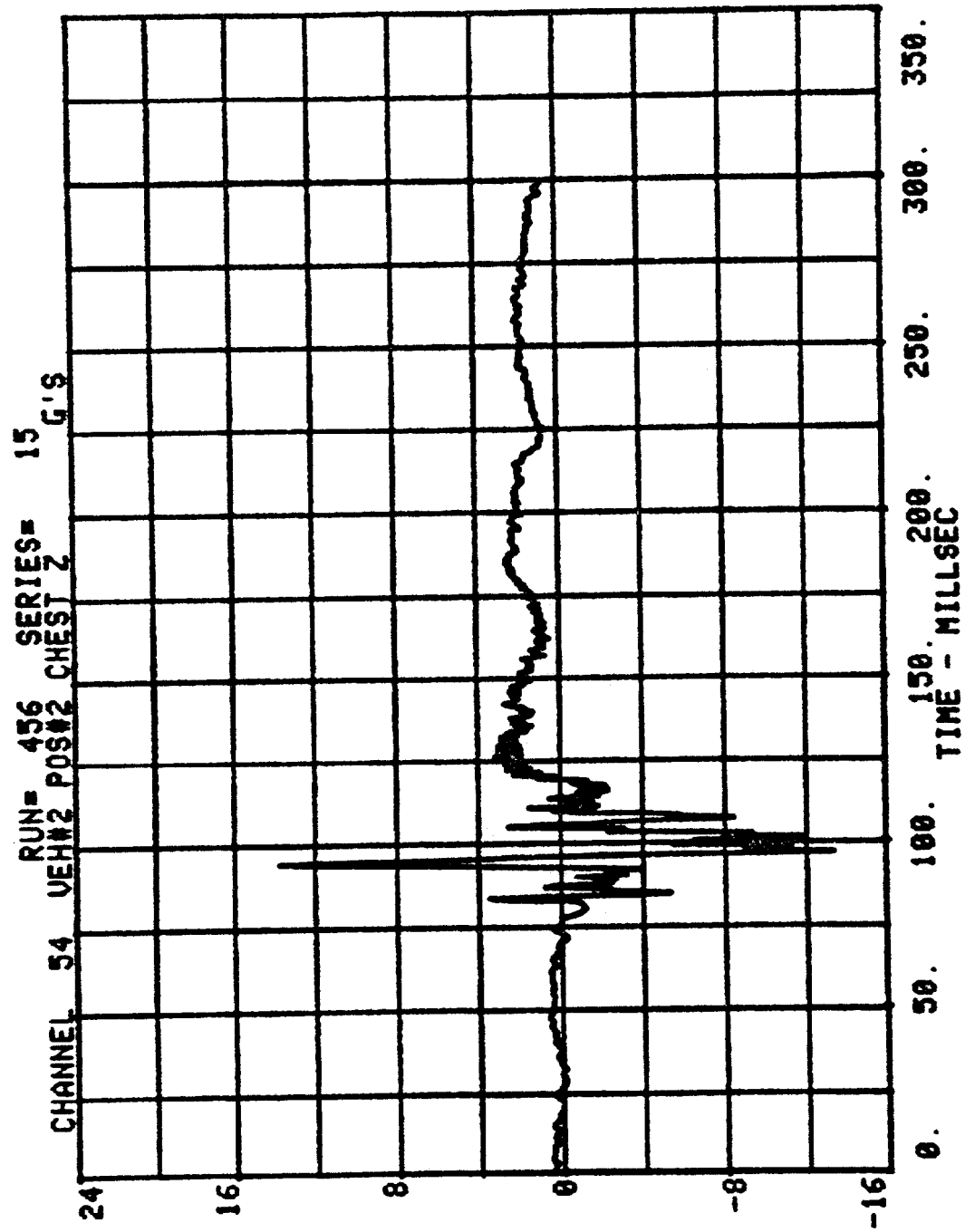

CHANNEL 50 VEH#2 POS#2 HEAD Y
RUN= 456 SERIES= 15
G'S
30
20
10
0
-10
-20
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

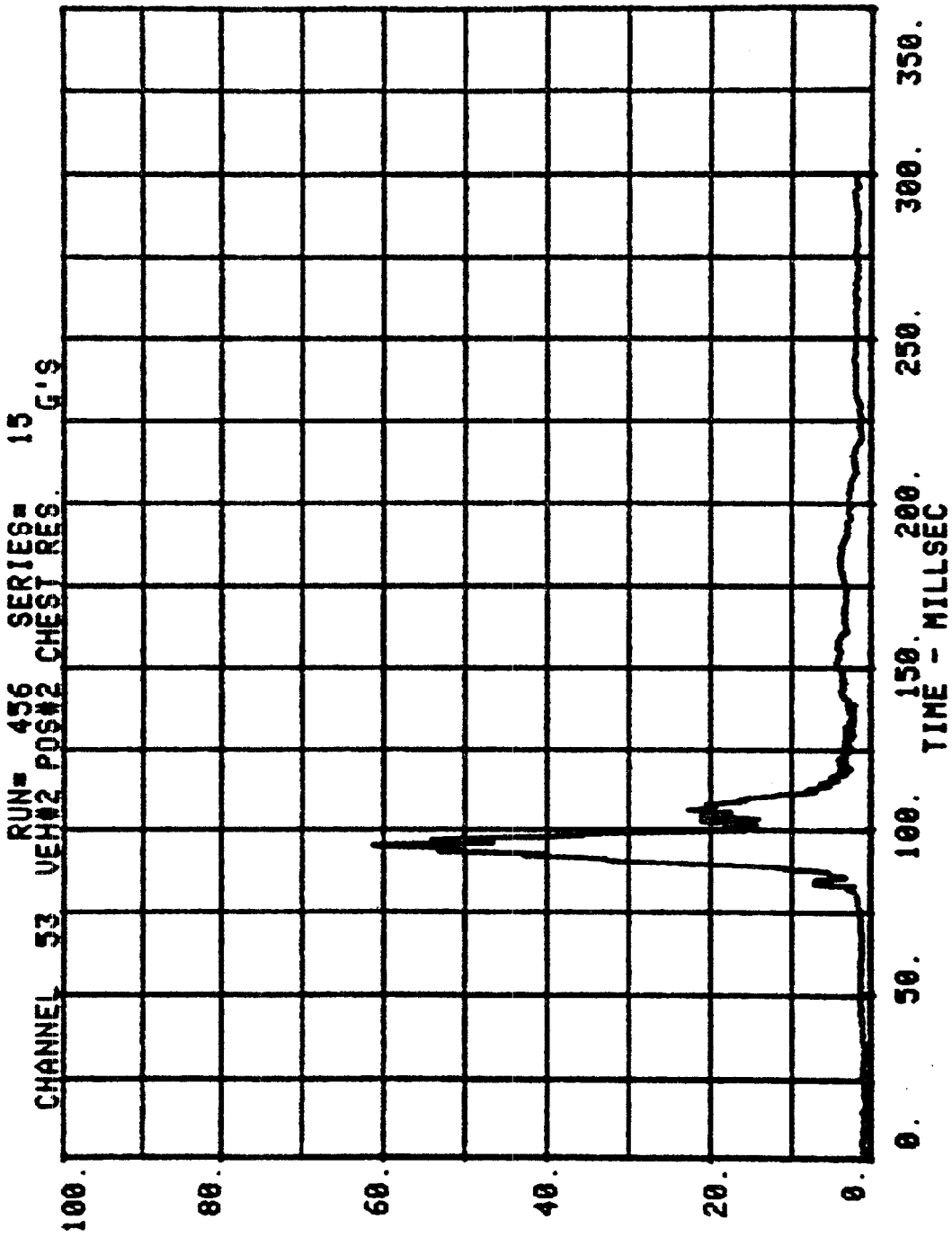

CHANNEL 51 RUN= 456 SERIES= 15
VEH#2 POS#2 HEAD Z
G'S
20
15
10
5
0
-5
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 52 RUN= 456 SERIES= 15
VEH#2 POS#2 HEAD RES. G'S
50.
40.
30.
20.
10.
0.
0. 50. 100. 150. 200. 250. 300. 350.
TIME - MILLSEC

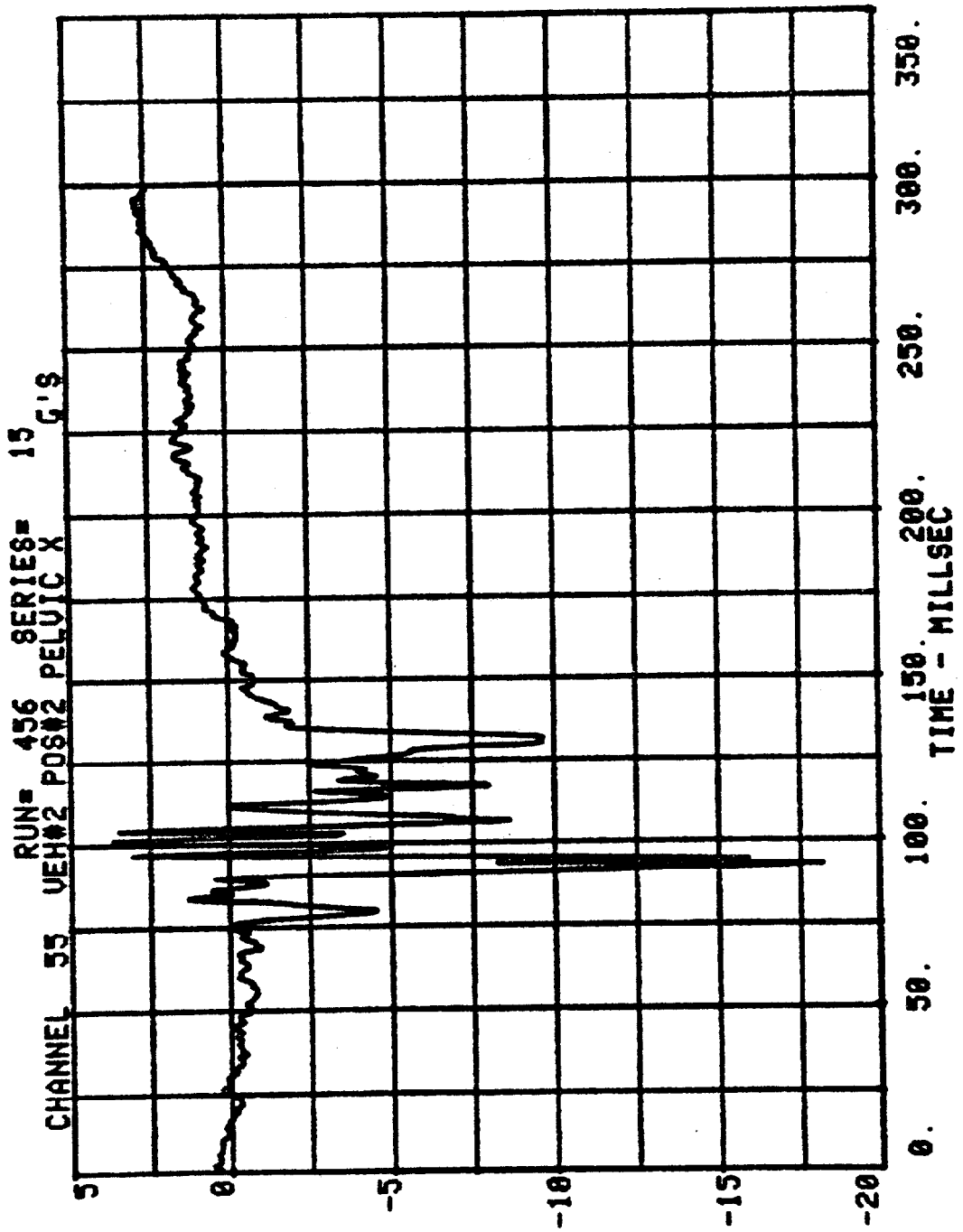

CHANNEL 52 VEH#2 POS#2 CHEST X
RUN= 456 SERIES= 15 G'S
15
10
5
0
-5
-10
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

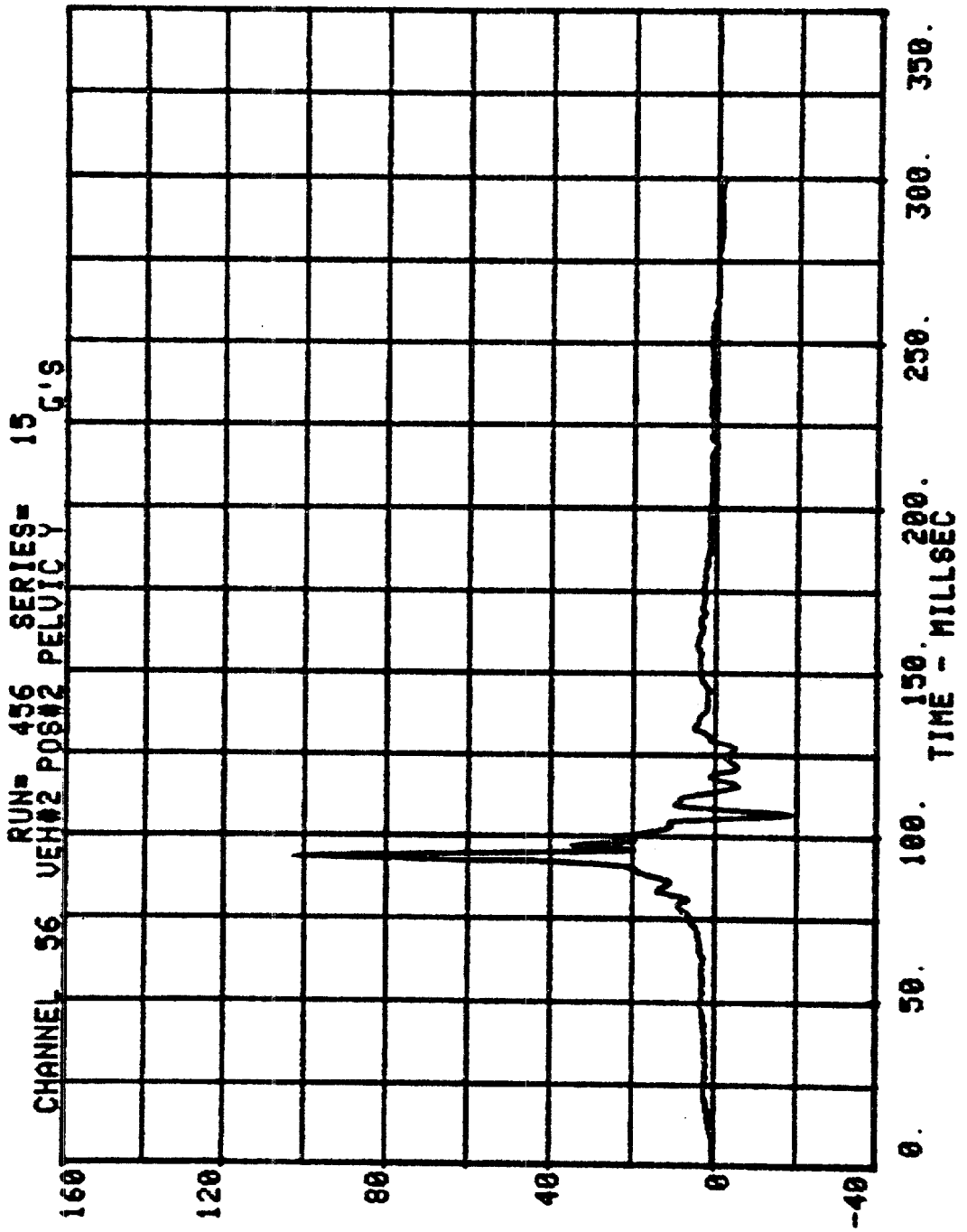

CHANNEL 53 VEH#2 POS#2 CHEST Y
RUN= 456 SERIES= 15 G'S
80
60
40
20
0
-20
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 54 VEH#2 POS#2 CHEST Z
RUN= 456 SERIES= 15
G'S
24
16
8
0
-8
-16
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 53 VEH#2 POS#2 CHEST RES.
RUN= 456 SERIES= 15 G'S
100.
80.
60.
40.
20.
0.
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC

(34)


CHANNEL 55 VEH#2 POS#2 PELVIC X
RUN= 456 SERIES= 15 G'S
5
0
-5
-10
-15
-20
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC


CHANNEL 56 RUN= 456 SERIES= 15
VEH#2 POS#2 PELVIC Y
G'S
160
120
80
40
0
-40
0.
50.
100.
150.
200.
250.
300.
350.
TIME - MILLSEC